MONITORING OF GOODS-DOCUMENTATION FLOWS IN MODERN LOGISTIC SUPPLY CHAIN, BASED ON BLOCKCHAIN TECHNOLOGY

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Abstract

The current supply chains, in fact we can speak of full modern, digital supply chains, are changing in an extremely dynamic way, requiring constant supervision and control of goods flowing through them. This is an extremely important issue for the protection of the health and life of consumers, which in terms of the idea of corporate social responsibility puts people at the center of attention and all business activities must be geared to their needs. Consumer safety is a priority. EU regulations oblige businesses to trace the origin of products in both food and consumer health and life industries. Companies are obliged to set up appropriate identification systems and procedures. They expect that the solutions recommended and implemented for them will not only allow for the correct tracking of the delivery of goods, but also protect against possible image failure due to a lack of control of their origin. The essence of the control of goods-documentation flows is to monitor the movement and origin of the product at each stage of the change of place in the logistic modern supply chain. For this reason, it is very important to monitor the quality and authenticity of the origin of the product in detail, at every stage of its journey, in order to react as quickly as possible in the event of a threat to the health or life of consumers. The maximum response time as well as safety can be ensured by using Blockchain technology for the requirements described above. In this article the authors have focused on the use of Blockchain technology in the implementation of logistics processes, in particular in the process of control of trade in goods and documentation.

Key words: blockchain, groceries, supply chain, traceability, GDSN, data sync., master data.

1. INTRODUCTION

Today's supply chains have opened up a world of connected trade far beyond what previous generations imagined, to an integrated, shared, intelligent, digital and highly efficient modern supply chain. The supply chain is now a series of independent, discrete, largely autonomous events controlled by marketing, production or distribution to end users. This is evident both in economic practice and in scientific research, which over the years has modified the scope of supply chain management (Fechner, 2017; Leuschner et al, 2013; Śliwczyński & Koliński, 2016). Digitization of these processes causes a continuous change in the supply chain, creating an integrated, modern supply chain, based on the transparency of processes occurring between the actors involved, from the suppliers of raw materials or components, through production processes to the supply of finished products. Such activities entail an unprecedented complexity of processes, based on multilateral cooperation to organize the movement of goods on the world trade market. Each participant faces new challenges in tracking the status of origin, authenticity and asset management as they cross organizational boundaries. Usually retailers and manufacturers place great trust in their direct suppliers, distributors or logistics operators. If any error occurs, they must quickly determine both the level of exposure of the potential end customer and the point of failure in the supply chain. It is important to stress the fact that the food or pharmaceutical supply chain, in particular, is extremely sensitive to any type of disruption and, above all, is a critical element in the functioning of society (European Commission, 2013). The biggest problems of these phenomena can be considered:

a) fraud in the food market - substitution, falsification, false information, British horsemeat scandal in 2013, Chinese milk scandal in 2008,
b) Illegal production - in particular in the fishing industry, around 10%-22% of total world catches are not recorded or supervised,
(c) Foodborne diseases - annually 1 in 6 Americans are ill due to foodborne infections. The total national cost of foodborne diseases is $93 billion per year (as of 2015),
d) Liability - severe consequences of abuses in the food supply chain - the average cost of a product recall for a company is $10 million, excluding damage caused to the brand and related to loss of sales.

The importance of these problems can also be illustrated by the following examples:

- The UK Food Standards Agency (FSA) reported 2265 food contamination cases between 2016 and 17, a 30% increase on the previous year,
- The World Health Organisation (WHO) has noted that 420,000 people die each year from contaminated food and almost one in ten people get sick from eating contaminated food.

Traditional methods of managing joint processes - such as traditional inspections, follow-up checks and reconciliation of documentation - are expensive, time consuming, prone to error and far from efficient. Therefore, in order to be competitive in the world at that time, a strong emphasis must be placed on modern solutions operating in integrated, digital modern supply chains.

2. RESEARCH METHODOLOGY

Taking into account the nature of this publication, whose main purpose is to determine how to monitor the flow of goods and documents in modern supply chains, based on the use of Blockchain technology, its authors decided to divide the research work into two aspects:

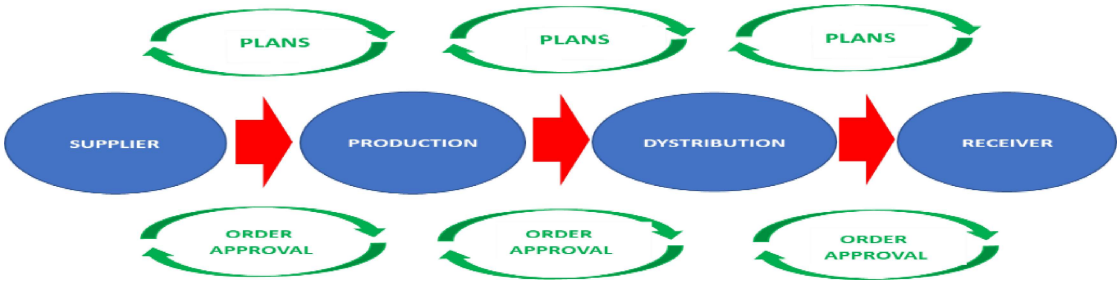
a. theoretical, identifying both the problem of the definition of this concept and the possibilities of its application in logistic processes,
b. practical, presenting the possibilities of using solutions resulting from international R&D projects and business solutions as a proposal for the implementation of individual key areas of application of solutions.

The research process presented in this article results from the logic of structural analysis of the identified research problem. The adopted methodology of research works assumes both theoretical research and verification of its assumptions in business practice. According to the authors, both aspects aimed not only at confrontation of research and practical considerations, but also at ordering the existing knowledge on the analyzed subject, cannot be conducted separately. The specificity of the research problem requires complex research at every level.

3. AN INTEGRATED, DIGITAL, MODERN SUPPLY CHAIN

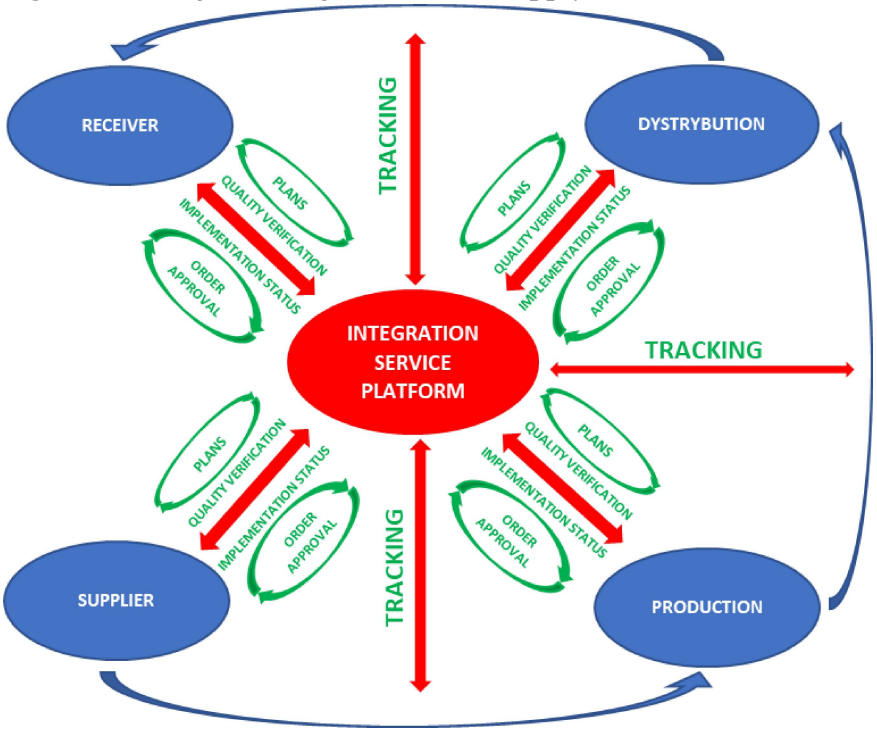
The changes taking place in the surrounding reality significantly affect the development of modern economy. These challenges include, among others, demographic changes or a change in the approach to eliminating the biggest barriers to development and basing development increasingly on knowledge, digitization and innovation. Electronation of processes taking place in particular enterprises or in the whole economy, being an integral part of them, will contribute to the improvement of their functioning, shortening the time of service and lowering the costs of economic activity. Such assumptions are the basis for the issues related to the fourth industrial revolution called Industry 4.0 (Pfohl et al, 2015). In order to fully implement them, the digitization of processes taking place in enterprises becomes necessary. The second aspect to which particular attention should be paid is the process of evolution of traditional supply chains, Figure 1 (Schrauf & Berttram, 2016) to the form of an integrated, shared, intelligent, digital and highly effective modern supply chain, Figure 2 (Schrauf & Berttram, 2016).

Figure. 1. Traditional supply chain.



Source: Own elaboration

Figure. 2. Integrated, digital, modern supply chain



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The supply chain is currently a series of independent, discrete, largely autonomous events controlled by marketing, production or distribution to final customers. Digitalization of these processes will cause a continuous change in the supply chain, creating an integrated, modern supply chain, based on the transparency of processes between the actors involved, from the suppliers of raw materials or components, through production processes, to the supply of finished products. The correctness of the events will depend on many key technologies:

- integrated planning and execution systems,
- visualization of logistics processes,
- intelligent supply and storage,
- tracking goods throughout the modern supply chain,
- ensuring safety and physical parameters in the process of goods exchange.

This approach will allow companies to react immediately to any disruptions in the supply chain and even to anticipate them in order to be able to model them fully, creating scenarios and processes operating in real time. This in turn will change the approach to managing your business, thereby increasing the competitiveness of your products or services.

4. TRACKING FLOWS IN MODERN SUPPLY CHAIN

Many requirements need to be met in order to be able to talk about correct modelling of processes in which action scenarios are based on decisions made in real time. One of them is a correct and comprehensive description of the product, so that

both the manufacturer, logistics operator, seller and consumer have access to the same information. This is extremely important because of the total change in the nature of the processes of events and the flow of information occurring in the logistical modern supply chains:

- The customer no longer distinguishes between sales channels,
- Shopping channels are no longer linear,
- Sales have naturally become multichannel,
- Customers expect a properly matched interaction,
- The same product identification is everywhere.

In addition to this, there are a number of different regulations that have an extremely important impact on the design process and must be taken into account. Among other things, for several years there have been two European regulations governing the scope of information to be made available even before the decision to purchase a product (Muszyński, 2016).

They are:

- EU Consumer Directive 83/2011 - defining the minimum product description necessary to make a purchase decision when selling a product over the internet,
- EU Directive 1169/2011 - concerning food products and the correct registration of allergens and ingredients dangerous to the life and health of consumers.

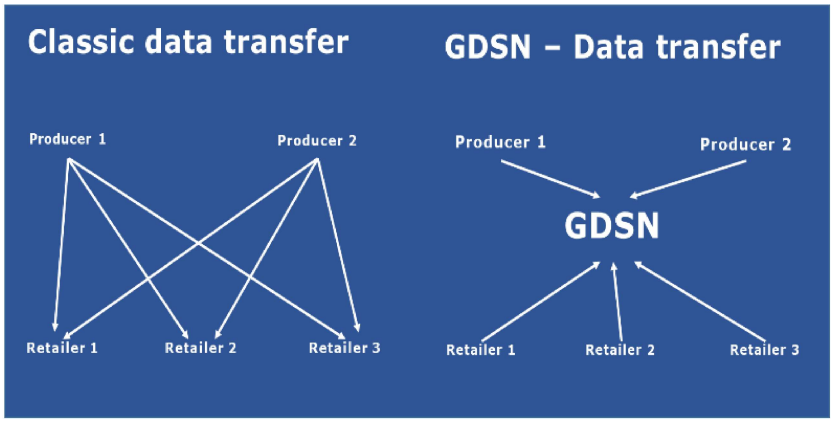
Today it is said that a product is only complete if it has a complete and up-to-date description. Hence the constant need to expand the information range to meet the needs of increasingly aware buyers looking for products with specific characteristics. Data quality is the key not only to properly conducted sales processes, but it is also essential for the health and life safety of consumers. Two important mechanisms are used to ensure this safety:

- Correct identification of products using the organizational and technical environment, which is GDSN - Global Data Synchronization Network.
- Tools from the traceability group - in other words, traceability, i.e. marking and tracking product batches from the start of production including the entire supply chain.

Product Data Synchronization with GDSN

GDSN is a standard for product data exchange and at the same time an IT environment, i.e. a platform that enables the collection, processing and escalation of product data in a consistent structured manner. So far, the supplier, cooperating with many retail chains and wholesalers, had to prepare each time a set of data according to individual patterns of particular recipients. Most often these were files in Excel format, formerly ordinary paper sheets Figure 3.

Figure. 3. Change the handling of product data using GDSN



Source: Own elaboration

With GDSN, it no longer needs to do so, as it concentrates data exchange allowing product data to be entered and retrieved in one standardized way. Automatic validation rules (checking) of this platform allow to eliminate basic arithmetic and logical errors contributing to the quality of transmitted information. For an easier understanding of the data structure, the list of attributes (single features describing the product - see Table 1) is divided into sections.

It should be remembered that to control the information exchange process, data on the sender, brand owner or author of the entry is necessary. Apart from the names and marketing information, dimensional and weight information is very important to improve the process of preparing storage sockets and store shelves. In the case of food products, on the other hand, food information, calories and, most importantly, the content of substances dangerous to health and life, such as allergens, are crucial.

Table 1. Attribute Thematic Sections of the Polish Product Data Model.

Attributes thematic section	Example
Orderly information	GLN suppliers
Product and packaging level identification in hierarchy	GTIN
Names and description of product	Name of product
Marketing information	Product marketing message
Legal requirements	Name of product regulated by law
Classification	Product classification e.g. GPC - Global Product Classification
Information resulting from Regulation 1169/EU	Allergen content
Origin of product	Country of manufacture

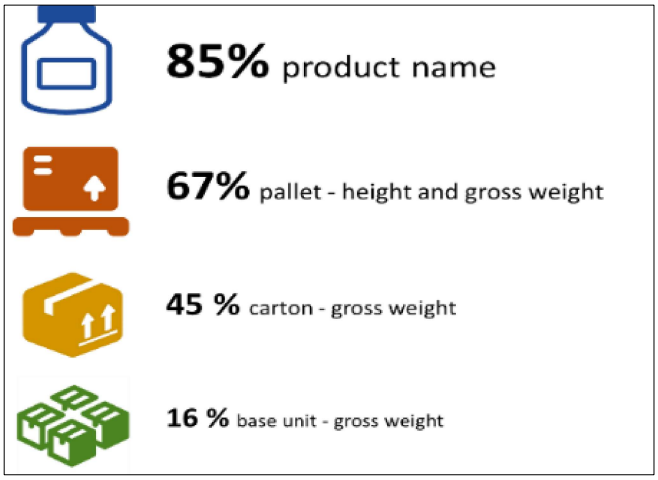
Dimensional weight information	Height / Width / Depth
Storage information	Maximum and minimum storage temperature
Durability/product warranty	Shelf life/useable life
Type of packaging	Wrapping/palette
Palettizing information	Number of pieces per layer/ Gross palette height
Packaging materials	Glass bottle
Sales information	Minimum order
Customs and tax rates, VAT classification	VAT tax
Control attributes	Data publication date

Source: Own elaboration

The use of the GDSN and its validation rules does not provide a full guarantee of the quality of the data it contains. For this platform to be a trusted source of basic information, providers need to replenish resources reliably. In many countries, including Poland, product data quality surveys were conducted. It turns out that the most frequent culprits are certain groups of attributes:

- Product name - changing the order of components, entering abbreviations and adding weights,
- Dimensional and weight information at cardboard level,
- Dimensional weight information at pallet level.

Figure. 4. Discrepancies in the product information between the manufacturer's card and the data from the retailer's system.



Source: Own elaboration

Successive GDSN implementations at suppliers and educational activities allow for a gradual reduction of errors. All these activities have a major impact on improving the loss of sales rates. Correct mapping of product data is the beginning of all processes between supplier and customer. That is why product data is often called master data. Thus, GDSN is treated as a kind of data template to which all parties in the modern supply chain refer. The information contained in this repository is constant, not transactional. Therefore, another important element is traceability, i.e. the ability to reproduce the flow path of a product or raw material in a variable environment.

Traceability

Traceability is the ability to track (recreate) the flow of goods in modern supply chains, together with the recording of the parameters identifying these goods and all the locations covered by the flow. This is important in order to ensure consumer safety. Traceability, therefore, consists in the detailed recording and collection of data at each stage of the delivery process, i.e. at the level of each of the actors involved in processing and sales. This registration is a key element of the whole process, as it allows for the smooth withdrawal of a defective product from the market when it may endanger consumers. This is called the so-called Recall actions. Such actions are registered and coordinated both by local sanitary and commercial inspections and by European organisations. On the basis of the GS1 standards, a number of guidelines and good practices have been developed, which successfully function as ready-made solutions to be implemented in various industries. An example of such a solution is the Global Traceability Standard (GS1 GTS), which defines the principles and requirements to be met when designing and implementing traceability systems. Among others:

- It defines the principles and minimum requirements for traceability systems,
- It describes typical business processes regardless of the chosen available technology,
- Indicates how to use GS1 standards in tracking the flow of goods,
- It characterizes the GS1 standards used in processes (barcodes, EPCIS, electronic documents GS1 EDI).

Hence, the most important benefits of using the GTS standard:

- Readiness for emergency withdrawal,
- Ensuring consumer safety,
- Increasing confidence in the brand,
- Fulfilling legal requirements.

Traceability is now widely used in various manufacturing industries. According to literature reports, these activities are absolutely used in the production of medical devices and drugs (Regan et al, 2013) and in the production of particularly fresh food products (Rábade & Alfaro, 2006). Traceability management is an element present both in production and logistics and thus has a huge impact on the efficiency of

processes in these areas. For example, the use of traceability at the producer of fresh products gives the opportunity to trace the raw material as well as the final product through the entire modern supply chain. This provides all data on the raw material, as well as on the individual processing steps it has undergone up to the final product. Traceability is also the reconstruction of the process in the other direction based on information about the finished product. This means that it is possible to trace the information about the raw materials from which it was obtained, as well as about the manufacturing processes used.

In order to effectively implement the entire traceability process in the modern supply chain, many necessary steps must be taken, such as:

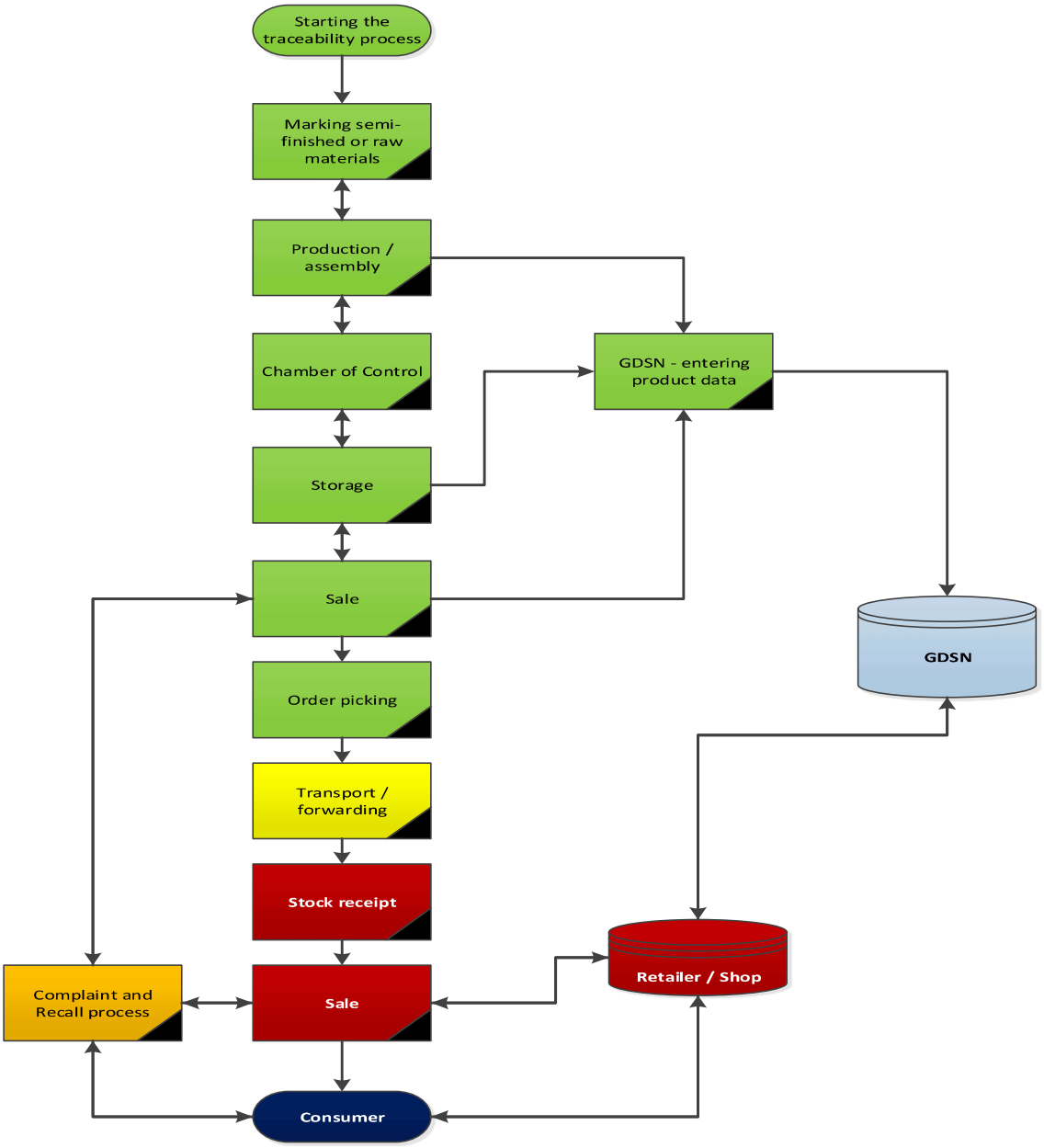
- Apply the GS1 standards for the entire packaging hierarchy - GTIN + lot number + date Best to + weight,
- Use the GS1 logistic label on the release, with the release number (shipment preparation), SSCC (Serial Shipping Container Code),
- Unify the labels on the packaging: Global Trade Item Number (GTIN),
- Unify label layout.EAN-13.

In order to ensure proper flow of the data stream, all the above information should be mapped in the ERP enterprise management system.

Synergy of systems in flow tracking

The previously described standards for the proper collation of product data and the possibility of reconstructing the production paths of the product guarantee consumer safety. Even before the product is on sale, it is possible to power all channels using modern data repositories. All stakeholders, i.e. the manufacturer as well as intermediary entities, and consequently the end customer, have access to the same up-to-date and comprehensive descriptive information. Thanks to this, logistics services know how to prepare the shop and warehouse for the acceptance of goods, and the consumer can verify the composition or parameters of the goods even before making a purchase decision. Despite providing high quality information, incidents related to production errors may occur. In industries such as medical devices and medicines and food products, contamination of an ingredient can cause reactions dangerous to living organisms. Therefore, apart from mapping the data in the GDSN, the manufacturer should register all stages of production and distribution of products in order to reconstruct paths and exclude defective batches and series of products from sale. Only such synergy allows for full control of both data distribution and sales and recall processes. An example of a model data flow using both standards is shown in Figure 5. The imposition of Blockchain technology on the above concept will develop the standards used. Additionally, it will increase the security of the flow thanks to sewn-in methods of resource authentication.

Figure. 5. Product data model flow using GDSN and Traceability.



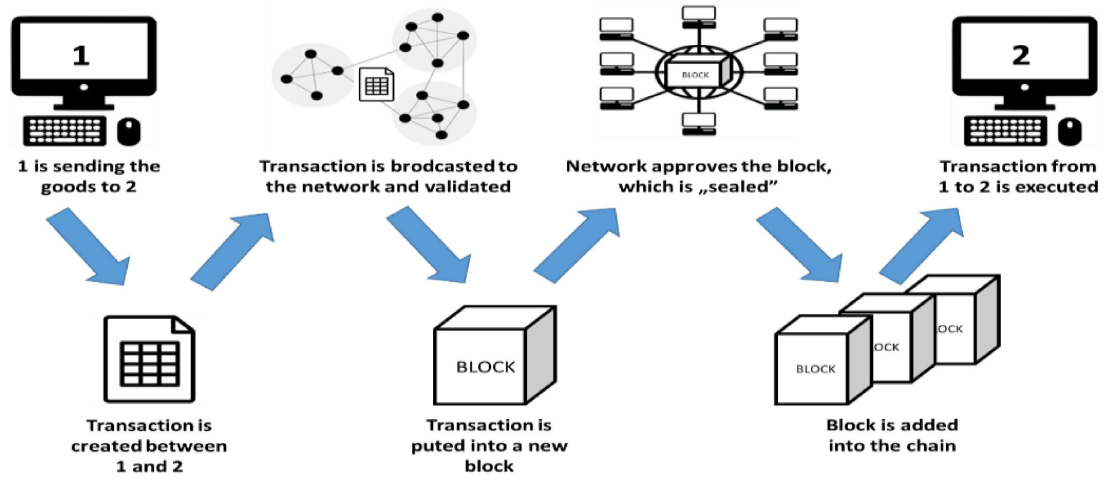
Source: Own elaboration

5. BLOCKCHAIN TECHNOLOGY

Blockchain technology was first used to control the cash flow of Bitcoin payments (Foroglou & Tsilidou, 2014). To understand why this kind of technology is considered so important, it is necessary to first explore its secrets. The increased demand for transparency in the supply chain is causing increased interest in Blockchain technology, which breaks down every movement per block and documents transactions every time a shipment changes ownership (Dujak & Sajter, 2019). Merging blocks together creates a record for the parties involved in the process

and provides detailed information related to each traffic to which all parties have access. This creates a permanent digital history as products pass through the entire modern supply chain from their original source to the final leg of the journey. The aim is to produce a single version of the truth, link information, ensure transparency for all parties involved in the supply chain and determine how they have participated in the movement of goods or services. In addition, the digital story is not owned or controlled by any of the trading partners, so it can be accessible to all verified chain players. No party may modify, delete or attach any records without the consent of the other parties in the network. Data generated using block technology can provide a greater chance to analyse information, which is becoming increasingly important in today's supply chain. Simply put, a block chain is a common book containing entries that cannot be changed or deleted retrospectively. Block chains are inherently decentralised, i.e. there is no entity with the power to control what is on the book. Optionally, they also include 'smart contracts', which are not contracts in the legal sense, but computer programs that enable automated execution of previously agreed procedures. An example of a simple 'smart contract' is the validation of content in a chain. The principles of the block chain are shown in Figure 6.

Figure 6. Blockchain-scheme for information exchange



Source: Own elaboration

6. SUPPORT BLOCKCHAIN TECHNOLOGY IN THE MONITORING PROCESS

One of the key questions posed by the current market situation is whether Blockchain technology is able to help solve problems in supply chains and, if so, the extent of their functioning. Looking at the issue through the prism that it is nothing more than an encrypted digital ledger, shared by many supply chain partners, providing lasting transparency and validation of transactions, we can clearly state that it is the ideal solution for the global supply chain. With this solution, anyone who has access to the network can see what is happening at any given time or follow any changes in real time. The reality is that Blockchain reflects a very decentralized and

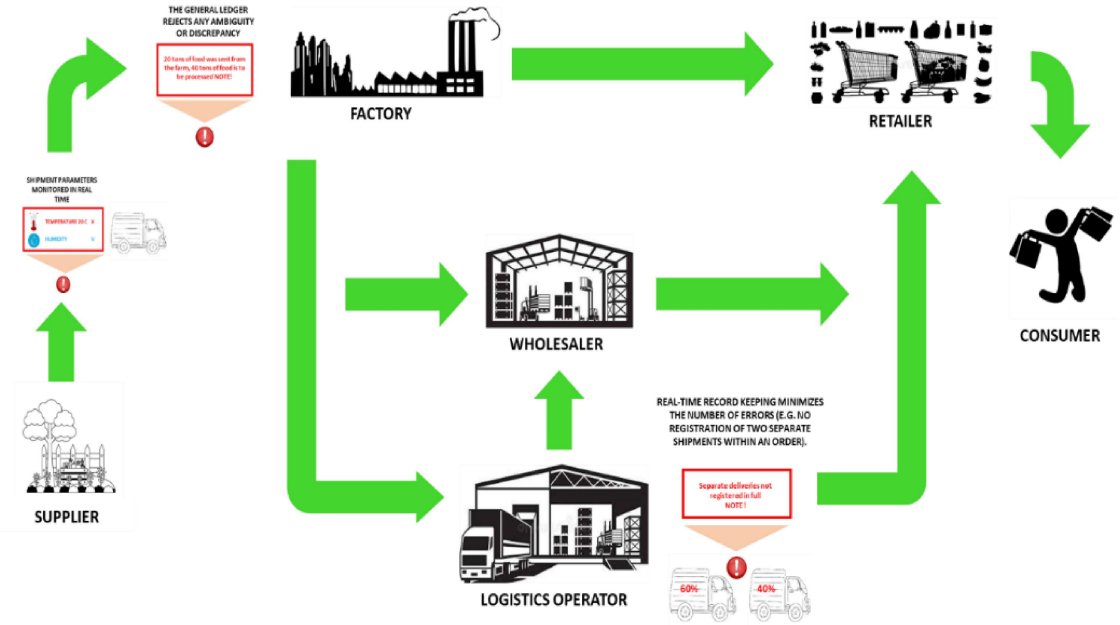
fragmented world binding its data, flows and activities into something that people can recognize as a record of the truth. It is accessible to all participants recording all kinds of information, secured by cryptographic tools that simultaneously protect the privacy of the participants in the chain.

For example, a company that manages the ripening process of products is linked to cold stores, transport companies and ultimately to buyers in order to provide optimal fresh products when they are needed. Using Blockchain technology you can monitor how the process is approved. It provides the ability to segregate or capture data and control its availability in order to confirm the process as defined, from sourcing the product from the manufacturer, through tracking the transport, to delivery to the consumer.

Given the transparency of the data, it can be concluded that Blockchain technology is used to digitally track and store all product information at all stages of the chain:

- data on agricultural activities, growing conditions, breeding,
- factory/processing plant,
- series numbers,
- expiry dates,
- temperature and storage conditions,
- shipment data, etc.

Figure. 7. Blockchain in the food supply chain

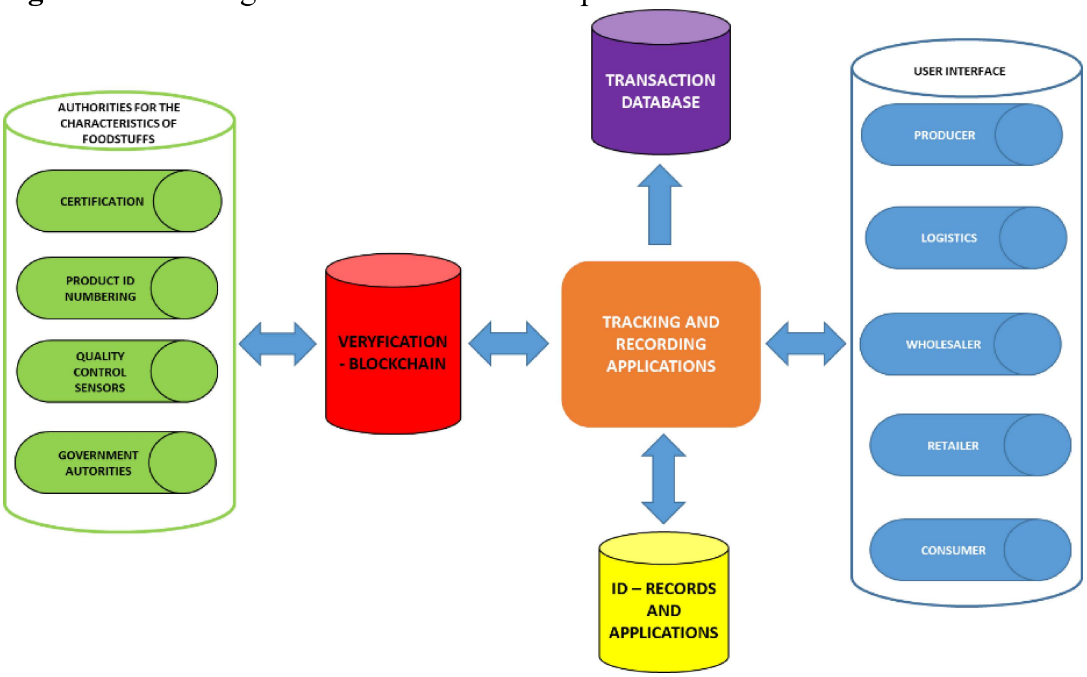


Source: Own elaboration

The key problem solved by Blockchain technology is how we can build a basis of consensus for secure information transactions without worrying about sensitive data when no node across the network can be trusted. This technology can guarantee security by using a mathematical algorithm mechanism (Steiner et al, 2016). Thanks to it, all nodes in the system can exchange data in an autonomous and secure way

without exposing the entire flow to any interference or misrepresentation in the information exchange. This is very important from the point of view of system architecture. The essence of the matter is best reflected in Figure 8.

Figure. 8. Exchange of information in food product's trade.



Source: Own elaboration

In this system, governmental organisations and regulators do not have a central oversight role over the exchange of information in the supply chain. They are only links and have a similar role to all other members. However, they also have their own obligations, such as imposing and applying strictly regulated rules of conduct to the whole supply chain and checking the authenticity of the information sent by each member. If a food safety risk is identified, they can take immediate remedial measures to address it. This approach, a decentralised traceability system, is becoming a new approach that increases transparency in the supply chain, reinforces the reliability of the information, allows real-time traceability of products and thus enhances security of supply.

One very important fact should be highlighted here. To speak of the success of the implementation of Blockchain technology, the following questions need to be answered as a matter of priority: does it make sense, will its application meet needs or will produce the expected results? To sum up the numerous discussions held with Blockchain technology experts over the last few years, several important criteria have been identified, which are the basis for determining whether it makes sense to use Blockchain technology in the planned solution. These are:

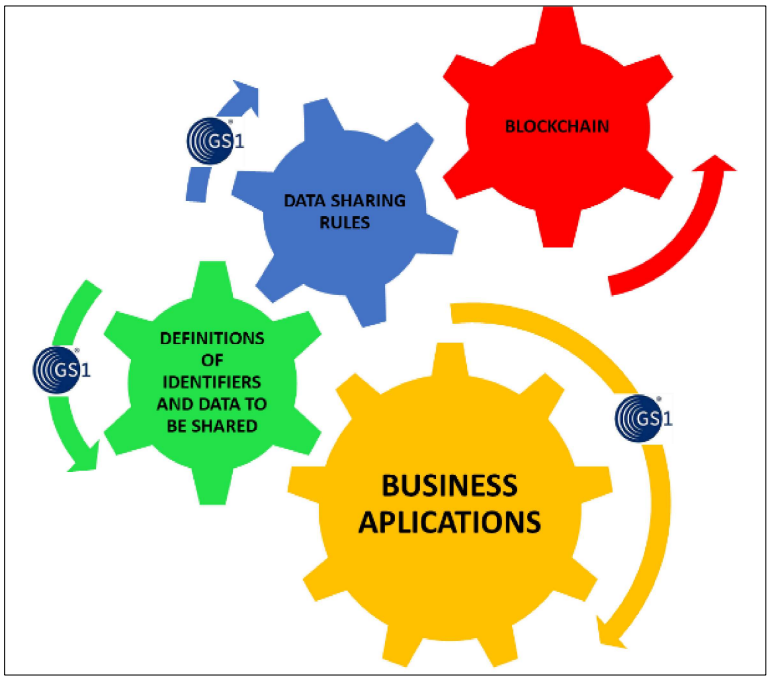
1. **Decentralisation of control:** Public and syndicated Blockchain networks usually regulate themselves, i.e. no organisation or government can control which data is added to the book, nor can they have the power to exclude parties from participating in an information exchange. The governance framework is established from the outset and can only be modified through an agreed

procedure. This feature obviously reduces the need for intermediaries, which is particularly useful in case of abuse of positions by intermediaries. Therefore, Blockchain technology can be used by an industry group to reduce the strength of competitors that could jeopardies their business.

2. **Transaction security:** Once the information contained in a block is validated, the algorithm saves it as the only source of truth on which all participants can rely. It is virtually impossible to remove or modify such recorded information. Moreover, since data is replicated on many nodes, there is a very solid protection against its loss, e.g. through malicious attacks, natural disasters or other actions aimed at destabilizing the information flow.
3. **Evidence of event recording:** the logic of attaching subsequent transactions encoded in individual blocks, which in turn are an integral part of the book, ensures that all records made in the event chain can be accessed. In other words, the structure of Blockchain technology has the so-called "fossil record" of all transactions recorded in a strictly defined chronological order.
4. **Cost-benefit balance:** Many Blockchain solutions offer the possibility to better balance costs based on the use of surreptitious currencies and some kind of micropayment mechanism. This is primarily about the possibility of sharing costs according to the number of transactions generated. For example, a small business with only a few transactions should make a much smaller contribution compared to a multinational with thousands or millions of transactions. However, it should be taken into account that distributed accounting systems are usually much more expensive than other data sharing systems (e.g. using centralised or combined databases). It is equally important to better distribute the overall benefits of additional data exchange. The latter, however, depends to a large extent on the system design. For example, if there is little useful data in the block chain, or if the parties benefit to a large extent from access restrictions, the benefits to e.g. the upstream provider are likely to be negligible in most cases.

None of these four criteria need necessarily be met in order to use Blockchain technology. At the same time, it would be best if the objectives, requirements and motivations of organisations considering implementing Blockchain technology coincide as far as possible with those of the technology. However, it is important to remember to make a conscious decision about implementing Blockchain technology, primarily based on the business benefit. The second key issue is that Blockchain is only a data sharing method based on strictly defined rules and processes operating in supply chains, based on communication or identification standards, which are implemented, among others, by GS1. The interdependencies of these elements are shown in Figure 9.

Figure. 9. Exchange of information in food product's trade.



Source: Own elaboration

As you can see, business applications are always the flywheel of any data sharing infrastructure which, in the interest of interoperability, should make the most of standardised data identifiers and attributes.

7. PRACTICAL APPLICATIONS OF BLOCKCHAIN TECHNOLOGY

- As the largest exporter of tuna in the world, the Thai Union group in Bangkok operates within a number of complex supply chains. First and foremost, it is about fighting the fishing industry against illegal fishing and human rights violations. The company has implemented a traceability system to monitor and manage the exclusion of illegal fish from the supply chain. It was the first company in the world to introduce a canned tuna tracking device so that consumers can analyse the route of their products from the moment they are caught in real time by verifying the species, the catch area, the voyage number or the fishing vessel.
- Cargill announced that in the run-up to Thanksgiving (November 2017), consumers were able to track Honeysuckle White turkeys from the family farm to the table. Consumers in selected markets can simply text or enter a code from the packaging at HoneysuckleWhite.com to access the location of the farm, view the history of the family farm, view photos from the farm and read the producer message.
- Belfast's advanced cryptography company, together with Adelphi's Scottish Ardnamurchan distillery, has developed a solution for tracing and

authenticating the whiskey produced. Each bottle has been labelled and certified for authenticity, allowing full control over the supply chain of each bottle from production to delivery to the final consumer.

- In March 2019, US postal operator United Parcel Service (UPS) and e-commerce company Inxeption jointly launched Zippy Logistics Blockchain. It is a B2B solution that allows you to create websites, download product information, plan orders and shipments, manage purchases, process transactions, track returns, conduct query marketing and analyze sales and marketing processes. In addition to the standard features, the system can also help you find optimal delivery routes, which are executed automatically. The sender has to determine the conditions and cost of delivery, after which the system will select the appropriate carriers, the delivery route and make financial calculations (all without human intervention). The "optimal" route is selected by searching for the shortest and cheapest route. UPS hopes that its system will reduce the cost and time of delivery and reduce overall industry inefficiencies.
- One of the world's largest freight forwarders, Kuehne&Nagel, uses Blockchain to optimize its Verified Gross Mass (VGM) logistics portal, which processes over 800,000 transactions per month. The new technology is responsible for the security and stability of information passing through the portal, as well as the automation of the transaction flow. The company hopes that this solution will reduce costs, speed up and simplify all processes, eliminate inconsistencies, and reduce errors and potential fraud. In addition, Kuehne&Nagel has carried out pilot tests on consignment note processes. A waybill is nothing more than an agreement between the sender and the transport company, which defines the latter's responsibility for the safety of the cargo during delivery and establishes the conditions for transport and delivery of the cargo. In this case the Blockchain technology is used to store data from the waybill and to track the related events: cargo transfer, violation of delivery conditions, financial calculations, etc.

8. SUMMARY

Using Blockchain technology in the food trade we can be sure that there is no risk of copying a given food item, e.g. in terms of duplication of sales. Each of the characteristics of the product, such as the product's certificate of origin or quality certificate cannot be duplicated. Most importantly, there are no gaps in the history, location and status of the food product. Instead, the whole process can be seen. Thus, if the consumer is certain of a potential health or life threat if a defective product is consumed, the seller can instantly see the entire history of the product flow, locating the source of the problem and eliminating it from the market. How quickly? This is demonstrated by research conducted by Walmart, IBM and Tsinghua University, which clearly shows that it took six days, 18 hours and 26 minutes to analyse the entire mango supply chain in the traditional way and only 2.2 seconds, based on Blockchain technology. According to the survey, more than 45.9% of respondents believe that

using Blockchain technology improves supply chain transparency, lowers transaction costs (24.3%) and increases trust between supply chain partners (13.5%). An example of this is the fact that financial transactions were made in soya exports from Argentina to Malaysia, in which HSBC participated. In his view, if all supply chain financing transactions in the Asia-Pacific corridor were based on Blockchain technology, the time needed for exports could be reduced by up to 44% and costs would be reduced by up to 31%. These figures show that the use of Blockchain technology is realistically viable in terms of financing financial transactions in modern supply chains.

As a new technology, Blockchain is still in a phase of change and there are some obstacles to its further development. One such barrier is the transactional potential, which limits the number of completed transactions to 7 per second. This is due to the sheer size limitations of the Blockchain while VISA can handle up to 47000 transactions per second (Trillo, 2013). What should be emphasized is the fact of dynamic development of a given technology, which overcomes particular barriers in an extremely effective way, leading to its continuous popularization. Therefore, every effort should be made to ensure that this technology has the widest possible application in modern supply chains, which is not necessarily possible in many countries. For example, in Poland, it is used primarily in the area of banking or archiving activities. It should be emphasized at this point that these are only estimates as no detailed research has been conducted so far to determine the level of use of Blockchain technology by Polish companies. This will contribute to the expansion of further activities in the field of research work on the above defined issue.

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