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INFORMATION TECHNOLOGY IN FORMULATION OF TRANSPARENCY STRATEGIES FOR FOOD CHAIN AND SUPPLY MANAGEMENT IN POLAND

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Abstract

The key aim of this paper is the presentation of current trends in the development of food distribution systems in Poland and their likely remodelling towards supply chains and networks. The new circumstances on the emerging markets such as Poland, in particular after its accession to the European Union, create new market challenges to be overcome with the use of information technology. The new technology will also support the remodelling of supply chains and networks based on the transparency strategy by improving the chain effectiveness, and build partnership relations between the actors by increasing their competitiveness. It gives possibility to apply a procedure of Rapid Alert System for Food and Feed in Poland.

Keywords: *information technology, transparency strategy, Food Chain Supply Management Rapid Alert System for Food and Feed in Poland.*
JEL classification: N74, O14

1. Introduction

Acceleration of changes in the food market occurring after Poland's accession to the European Union in 2004 caused an increased variability and fragmentation of the food market. As a consequence, the significance of food quality for the buyers is rising continuously. Higher importance of food quality is driven by the principles of quality management, having roots in the principles developed by E. Deming. The fragmentation of the food market and the rising significance of quality are accompanied by the need to reconstruct the traditional and build modern food supply chains and networks.

2. Megatrends and their impact on the food market.

The enlargement of the European Union in May 2004 by ten new states has boosted the earlier trends in the conditions of food market in terms of *economics, demography, social and cultural, and legal aspects, as well as technology and the protection of natural environment*, leading to increased competitiveness [Trienekens, van der Vorst 2006, Szymanowski 2008],.

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The phenomena of business expanding beyond the national borders has been strengthening since the 1960s. It was and is related to the lifting of barriers in international trade, expansion of super-national corporations in charge of almost three quarters of all trade, and revolution in transport and communication. Among the key drivers of globalisation is *networking*, i.e. the use of Internet resources (World Wide Web) in trade as a business tool for the creation and exchange of new value and execution of low-cost e-transactions. E-commerce crosses all barriers of time and space by providing Internet-integrated logistics to support businesses.

Partnership-based logistic chains and networks are an instrument able to meet the aforesaid market needs, in particular with respect to the emerging markets. Such chains and networks should be financed with public funds and joint public and private undertakings.

The development of logistic chains on the international scale is related to certain prerequisite factors that can be grouped as follows:higher needs and expectations of customers and the market in respect of products and services;

- globalisation of supply and distribution markets;
- availability of natural and human resources;
- deregulation and the economic policy;
- development of information and communication technology (ICT).

Following are the key conditions that drive the needs and expectations of customers and the market:

- Fragmentation of buyer markets.The creation and satisfaction of individualised needs and expectations of smaller buyer groups leading to, thanks to ICT, establishment of a market with symmetric one-to-one relations;
- Product life.The majority of sectors are mature and need tools to retain customers rather than win new buyers. Such tools include product line management, handling of promotional activity, adding new value for customers, e.g. via extra information;
- Higher degree of innovation.This tendency is reflected in the large number of new products, production processes and organisational solutions, all leading to shorter product life and higher logistic requirements in terms of both size, time, destination and services, which apart from transport, storage and packaging also include servicing, insurance, financing, payment monitoring and information to customers;
- Compressed prices. The above conditions lead to higher competition on the domestic markets giving rise to fights for customers and price reductions.

The main drivers of supply chain development are, in respect of **globalisation of supply and** distribution:

- Centralisation and geographic concentration of distribution via closing of local and domestic hubs in the 1990s in favour of pan-European logistic centres. The process of minimising the quantity of logistic hubs is accompanied with their stronger geographic presence in the area of Benelux, with the Netherlands holding to almost 56% of hubs. These logistic centres are ready for multi and inter-modal transport, i.e. transport that occurs across various platforms and means, and provide comprehensive logistic services via virtual logistic platforms;
- Logistic services outsourced through specialist logistic service providers, called Fourth Party Logistics, or 4PL. Their mother companies are in possession of own transport and storage resources and establish logistic operators that provide high-quality service across entire Europe for reduced prices;

- New production and storage technology invented based on the development of the production iinfrastructure and in particular the implementation of new IT solutions that provide new interactive ways of supplier-buyer contact. The new technologies used in the organisation of production include flexible organisation of production- processes synchronised with order flow, inventory management (Continuous Replenishment Process) leading to a large reduction of stock required from suppliers.
- New techniques in demand and sales planning. By initiative of large retail networks acting in cooperation with large food suppliers, a concept of Efficient Customer Response has been coned at the beginning of 1990s. Efficient Customer Response means a customer-oriented supply chain intended to better satisfy the needs and cause higher sales and cost reduction. This issue is addressed in the Collaborative Planning, Forecasting and Replenishment (CPFR) concept, which supports the synchronisation of forecasting and planning across retail networks and producers, yielding higher effectiveness of both. At the same time, it provides grounds to separate daughter companies specialising in logistics.

Deregulation means the creation of *the European transport policy,* which aims at developing the *Trans-European Network (TEN),* as a consequence of the Maastricht Treaty of 1995. The network is the primary component in the infrastructure of logistic networks that process large and frequent cargo. In 1997, *Transport Infrastructure Needs Assessment* was founded by the European Union, a programme intended to procure financing for the core investments in the transport infrastructure. The programme for the development of the logistic centres as hubs able to provide comprehensive servicing for all transport and *intermodal cargo* will contribute to a lower burden for the truck transport, less impact on the natural environment and improved quality of life in the conurbations.

3. Development and Impact of Information and Communication Technology on Remodelling of Food Supply Chains and Networks

The last group of conditions that determine the development of supply chains is related to **the Information and Communication Technology (ICT).** This includes the need to design *a global all-industry information standard* that would assure compatibility of basic data across products and services offered by various trade partners. Such standard is satisfied via *Global Data Synchronisation (GDS),* a model built based on a certified network of national electronic product catalogues, developed using EAN-UCC -*European Article Number Association and Unified Code Council.* It is commonly referred to as the barcode system used in wholesale and retail, as well as in logistics and transport. The applications of EAN-UCC expand and today it is the key language in digitisation of trade. EAN-UCC is used in *Electronic Data Interchange (EDI),* a technique leveraging non-paper carriers of information to connect IT systems of trading parties and send standard documents such as invoices, orders, production schedules in the electronic version. EDI's advantages include full independence of any single hardware or software platform. The global standard for EDI is WebEDI that uses the World Wide Web to connect trading parties.

The change from *the production-oriented approach towards customer focus* is possible via *cooperation with supply chains and networks* that should operate based on the principle of partnership and use joint resources to track and monitor the flow to: increase the added value by enabling international sales of products and services, observance of quality standards and food safety, incorporation of expertise, technology and new organisational

models. It necessitates designing *the strategy for remodelling of supply chains*, which will increase the competitiveness of entire chains rather than singular actors. The strategy will incorporate information technology to improve its *transparency based on quality standards, food safety and innovation in the introduction of new products, technology and organisational models for the market.* This aim will be realised based on the abovementioned prerequisite conditions, by applying *the process-based approach* in accordance with *Deming's PDCA principle (Plan-Do-Check-Act) that enforces sustained improvement.*

The key aim of this paper is the presentation of new market challenges to the use of information technology to support the remodelling of supply chains and networks based on *the transparency strategy* by improving the chain effectiveness, and *build partnership relations* between the actors by increasing their competitiveness.

To justify this hypothesis we shall use a series of arguments. First of all, information technology can be implemented once the principle of remodelling of supply chains and networks is applied based on the incremental approach of Davenport and Deming's PDCA rule. The target is the opportunity to build a reference model, founded on best practices, that would incorporate the concepts of *Extended Enterprise* and *Cooperating Extended Enterprise.*

Another argument are the forms of trade that experience the fastest pace of development thanks to the market globalisation, and their evolution in the World, Europe and Poland, with a special focus on whole and retail sales. The new forms of wholesale trade that have emerged during the transitory period of the Polish economy are related to *wholesale markets, commodity exchanges, tenders* and the differences between them. An example of the latest form of trade that uses information technology is the Warsaw Commodity Exchange. Another tool is *the distribution service centres* that support wholesale and large retail networks. The rising role of information technology for the remodelling of supply chains is accompanied by changes in *the logistic infrastructure.* An example is *the logistic centres*. Their specialist operations can be exemplified via the evolutionary model of Wielkopolska Agri-Horticultural Wholesale Market PLC.

The rising role of information technology for the remodelling of food supply chains is based on *Automatic Data Capture (ADC). ADC* uses *bar coding* that originates from *Radio Frequency Identification Data (RFID)* – now used in the latest code generation called *Electronic Product Code* (*EPC*), and uses *Electronic Data Interchange (EDI).* Both make the data identification standard called EAN-UCC, which is used to *track and monitor cargo* (food)

Another argument for the role of information technology in the remodelling of supply chains is its application in the management of production plants that are the second link in the supply chain after the retailer networks. The implementation of *the concept of referential model of Manufacturing Planning and Control (MPC)* and its evolution towards *planning support systems, i.e. Material Requirement Planning/ Enterprise Requirement Planning (MRP-ERP),* has been documented via the implementation of planning support systems in the food processing industry. The future *directions for the development of planning support information systems in the food industry* that use *quality and time management* will, via tools such as CPFR, realise *the concepts of Extended Enterprise* and *Cooperating Extended Enterprise.*

The next argument for the future role of information technology in the remodelling of food supply chains is the directions of application of the Internet for the development of alternative channels of distribution in the area of wholesale and retail. Wholesale uses *trade*

and logistic platforms, for example *NetBrokers* - the largest e-wholesale platform for agricultural and foodstuffs in Central Europe. In retail, *alternative channels of distribution* are applied via *e-shop* model. The pros and cons of e-sales will be presented using the example of Poland's oldest supermarket, ToTu, and the hybrid sales platform of *Piotr i Paweł* food store. The reports on operations of on-line shops in Poland, prepared by the Batory Foundation and the Office for Consumer Protection, indicate the next tendencies for this rapidly developing alternative food sales channel. Another tool that supports the role of information technology is *e-auction* – a platform connecting both individual and small business buyers. The best known example of application of *e-auctions* is the fruit and vegetable exchange operating in the Netherlands.

4. Conditions for transparency and flexiibility strategies. GS1 System

The creation of *global infrastructure for cargo identification and tracking* in the form of the GS1 system will enable formulation and implementation of supply chain strategies that incorporate ***the principle of transparency*** *and are realised* ***in two forms – cost leadership in food supply mass markets, which use outsourcing, and the differentiation strategy, which ensures food safety on niche markets.***

Global System, Global Standards & Global Solution-GS1 is a leading organisation dedicated to the de-sign of global standards for modern supply chain management.

GS1 is entering a new level of activity by offering new products and services:

- Global Data Synchronisation Network (GDSN) and
- Global Registry (GR), which enable easy and effective synchronisation of trading partner data across the world;
- Electronic Product Code (EPC);
- Traceability, i.e. solutions for tracing the movement and origin of goods along the whole supply chain.

The GS1 Global Office will be helping to carry out the above-mentioned tasks. One of the pioneering concepts, planned for the years 2006-2009, was the implementation of GS1 standards in the area of raw materials, semi-finished goods and packaging, called upstream integration. Similar moves will be taken on a national scale in Poland. The goal will be to work out a concept for the implementation of upstream solutions on the Polish market [Gawrońska 2006] (see Table 1).

Table 1. GS1 Strategic Plan 2006-2009

Objectives	Projects
Supporting key standards	Barcodes eCom GDSN EPCglobal
Diversification of the service line – introducing new standards and services	•Traceability •Upstream initiative •Patient safety •Learn (GS1 Institute) •Certification •Global Data Driver
Implementation activity in new sectors	EPCglobal, Traceability, Upstream, Patient safety

Source: A. Gawrońska, 2006. Globalne Forum GS1, Logistyka, 3, p. 93.

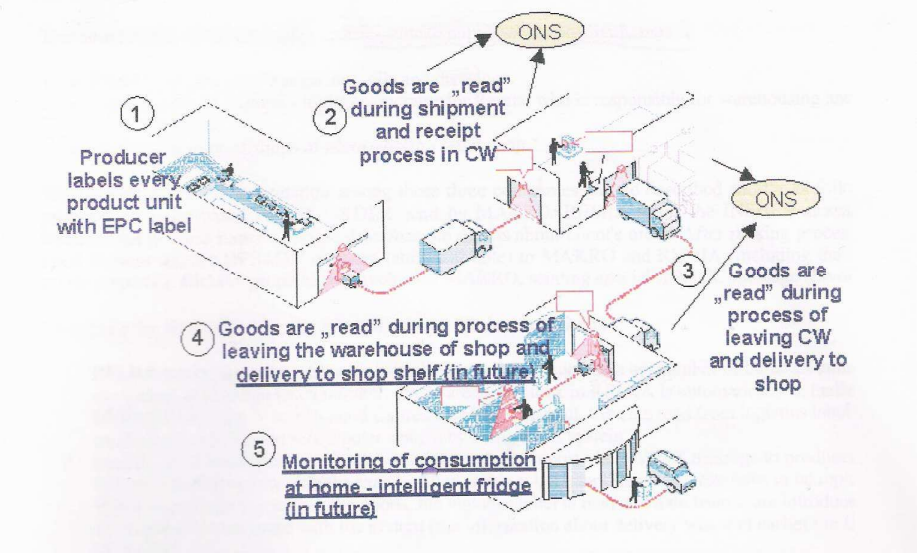
In Poland, an important development in 2005 was the establishment of EPC Forum – Poland. It enables business to share experience with other EPCglobal members committed to the implementation of new EPC technology. The Forum also provides access to information about EPC, research findings and soft ware specifications.

Electronic Product Code and the EPCglobal system

Data transfer standards in the GS1 system use the Electronic Product Code (EPC) and form an open global network (EPCglobal). EPC combines two identification technologies: via radio frequency (RFID) and through the Internet.
The EPCglobal Network:

1) The producer marks every product with an EPC tag in order to identify the item in the supply chain;
2) EPC readers are devices for reading data from EPC tags. They link goods flows with information flows and are connected to middleware. The tag data are read when the product is received by he Distribution Centre;
3) The use of special software –middleware which serves as an interface between the RFID reader and the trading partners' application programs and the Internet. It is used to manage the flow of information in the EPCglobal Network.;
4) Information about every user is stored in the public network through the Object Naming Service (ONS). It enables data sharing among trading partners on the basis of EPCs. As a result, it is possible to read descriptions of products moving from the Distribution Centre or warehouse to retail outlets;
5) The EPC Information Service (EPC IS) is a server used to monitor household consumption. The server uses the Physical Markup Language (PML), based on XML, and is a product description method allowing the storage and transfer of product data.

The ability to monitor cargo movement in real time is the primary advantage of the EPCglobal system as it ensures the transparency of the whole supply chain. The architecture of the EPCglobal Network contains a description of standards and specifications for the whole network and its indivi dual elements. The architecture of EPCglobal is presented in Figure 1.



Source: ECR Europe 2004, ECR-Using Traceability in the Supply Chain to Meet Consumer Safety Expectations, Global Commerce Initiative EPC Roadmap, GCI/IBM.

Figure 1. The whole supply chain by use of EPCglobal system

The architecture of EPCglobal consists of three sets of standards:

- *EPC data exchange standards* – covering users of the EPCglobal Network; through the exchange of information with other members, they increase their knowledge about the physical movement of cargo after it has left the enterprise;
- *EPC infrastructure standards* – they define standards of interfaces for infrastructure associated with collecting and storing EPC data;
- *Standards for the physical exchange of EPC objects* – covering EPCglobal Network users who physically exchange cargo between each other; it is identified by unique numbers written in the EPC tag. In Poland, the database of EPCglobal members is administered by the Institute of Lo-gistics and Warehousing as a national GS1 organisation. Polish EPCglobal suppliers/ partici-pants offer equipment in compliance with the GFN2 standard.

The implementation of IT traceability rules in food supply chains and networks includes the tracing of data acquired from various sources and rules governing the organisation of traceability systems.

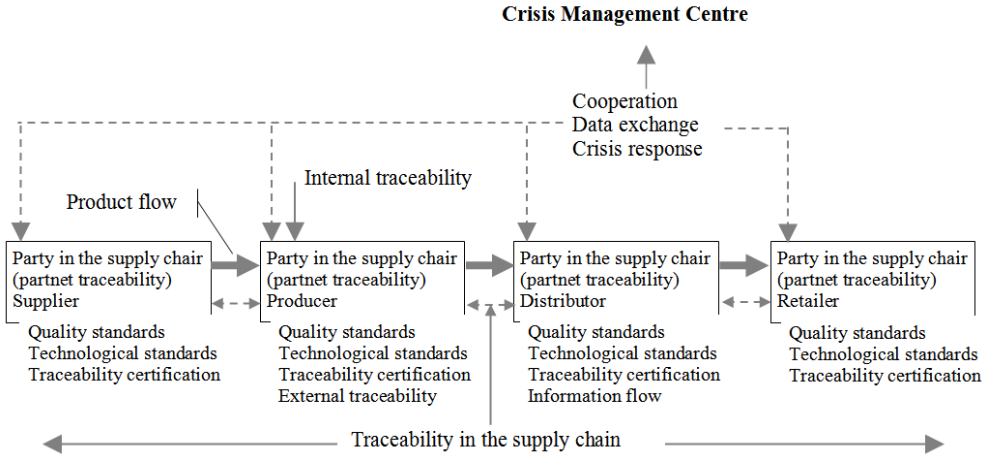
5. The principles of food traceability system, its integrators and benefits for participants

The following interrelated conditions have to be met to provide a comprehensive solution to product security in the global supply chain, one ensuring the required product quality, efficient product tracing and the ability to withdraw the product from the market:

1) standard identification of the product (cargo, logistics unit) at each stage of its flow through the supply chain;

2) standard identification of the location of all partners in the food supply chain;
3) electronic data exchange based on global traceability data standards;
4) detailed reproduction of product and information flow processes as a basis for a traceability reference model in international supply chains; data exchange requirements meeting food traceability requirements have been imposed on the products identified, partners located and process descriptions;
5) standards for the storage and sharing of data concerning external (outside enterprises) and internal (inside enterprises) traceability systems;
6) technological standards for micro-devices used to identify and control conditions of food production, storage and transport and automatic product flow identification;
7) quality standards for food production, storage and transport in compliance with quality norms in force in individual sectors and countries; necessary for the correct, reliable and continuous operation of the traceability and tracking system;
8) certification procedures for compliance with the traceability system;
9) standards for cooperation and the exchange of enterprise data with Crisis Management Centres based on the organisation of European Union's Rapid Alert System for Food & Feed (RASFF) within trading standards department and safety control structures.

Standards of cooperation with Crisis Management Centres [Solutions to Trust and Reliability, 2007] Food tracing in global supply chains requires combining internal data (internal traceability) - like for example product serial number, batch number and production date (GTIN) – with external data (external traceability) – like for example the location number of the par tner (GLN) and number of the logistics unit (SSCC). Figure 2 presents a diagram of product tracing in the supply chain show--ing the role of the Crisis Management Centre based on the organisation of Rapid Alert System for Food & Feed (RASFF).



Source: Author's own elaboration

Figure 2. Role of the Crisis Management Centre in the supply chain traceability system

The traceability system functionally supports the exchange of information between the Crisis Management Centre (CMC) and participants in the food supply chain. The rules of cooperation are regulated by the requirements of the RASFF system. The data on products,

processes, transactions and partners collected by supply chain participants are shared in the case of a threat. The data should be shared by supply chain participants within 24 hours. After analysing the level and scale of the threat, the CMC may order the withdrawal of the product from the market and all supply chains.

The system proved effective in 2007 when bird flu cases were discovered in Poland.

Benefits for supply chain participants

The use of the Automatic Data Capture (ADC) technology in the supply chain differs depending on the role played by its participants [Trienekens, Van der Vorst 2006].

In industry, this covers:

- Storing the detailed information which makes it possible to retrace the history of every product;
- Verifying the content of packages before their dispatch and checking them against the order;
- Problems solved at their core; general improvement in quality;
- Enhancing the efficiency of product selection and packing;
- Reduction in demand for labour.

At a Distribution Centre, this covers:

- Inventory control, quality guarantee and a reduction in the time needed to carry out an audit;
- Marking and identifying goods in packages to enable their storage without the need to open the packages;
- Confirming the content and validity of information, and eliminating the need for manual package marking in the case of packages which require special handling;
- Eliminating human error;

In transport, this covers:

- Product location ensuring on-time delivery;
- control of transport conditions; a reduction in product damage;

In the retail sector, this covers:

- Earmarking almost 100% of the goods for purchase; an increase in sales and improved customer service;
- Real visibility of the absence of the product in the shop; improved quality of sales (accurate orders, order);
- Preventing customers from leaving the shop without making a purchase;
- RFID, which ensures safe payments, accelerates transactions; the implementation of CRM.

6. Summary. Competition strategies pursued by the integrator of food supply chain management

The use of information technologies, as presented above, enables the effective application of both strategies – the transparency strategy and the flexibility strategy – which complement each other.

The overriding strategy resulting from information technology support is the above-mentioned supply chain transparency strategy. The share of information technologies in its implementation may vary.

There are three substrategies supporting the transparency strategy:

- *compliance substrategy*, i.e. supporting the achievement of the quality assurance level through quality management methods at each link of the supply chain with the use of IT;
- *substrategy oriented at improving processes* – concerning the implementation of traceability principles only in selected links of the supply chain, i.e. with a limited use of IT;
- *market-oriented substrategy* – concerning the implementation of traceability principles and monitoring supply sources at each link of the supply chain with the full use of IT.

Special features of competition strategies on the food market

Two types of food markets can be distinguished by food durability and the degree to which it has been processed:

1) **the market for fresh, unprocessed food** - distinguished by a short shelf life, time pressure in delivery and temperature control, varied production and distribution times, a varied product range, difficulty in inventory planning, untapped production capacity;
2) **processed food with an extended shelf life** - with no time pressure, and a predictable level of supply and demand, which makes it easier to plan inventories and utilise production capacity.

Two basic strategies based on the complexity of the food market and the scope of integration can be formed on the food distribution market:

- ***Strategy on markets for mass food consumption*** – focused on minimising the price/logistics costs, i.e. based on efficient systems; its integrators are large food producers;
- ***Strategy on markets for fresh food consumption*** – focused on the delivery of products of high quality with a number of additional services offered, i.e. based on flexible systems; its integrators are large retail chains, and

Strategies for cooperation between large retail chains and large food producers, with mass food supplies and a specific share of brand-name products (company and private brands). Its structure is changing thanks to the introduction of product innovations. An example on real markets is the ECR strategy – category management from the demand side and continuous inventory replenishment from the supply side.

A strategy of building partnership relations for cooperation between large food producers and large retail chains will be implemented for operations on virtual markets [Szymanowski 2008].

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