UNIVERSITY OF TURKU

INTELLIGENT PACKAGING

Tetra Pack

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Abstract

At present, food waste is an ongoing major problem worldwide. This problem has affected food security, caused financial losses, and many environmental problems. It has become the biggest challenge and matter of concern for the food industry. To make sustainable changes and solve this global issue, Tetra Pak and HID Global, with their joint venture, develop innovative intelligent packaging that uses a gelatin tag as a biosensor. This essay highlights how this innovative technology can help the food industry minimize food loss and food safety concerns. It also highlights the collaborative effort of two successful companies to develop innovative technology to tackle a major global issue.

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1. Introduction

Food safety and quality assurance are two of the most vital elements that the food and packaging businesses must ensure. To do so, modern technology has produced the term smart packaging solutions which have features like sensors, QR codes, indicators, tracking devices etc. that enhance the functionality, safety, and usability of the packaged items. This type of packaging helps to increase markets globally, complies with national and international food safety laws as well as protects food from chemical and infectious pathogens. (Schaefer et. al.,2018)

Our creation is a sophisticated packaging method for high-quality, environmentally friendly product solutions. This will benefit the parent company by improving product safety, tracking freshness through microbial growth monitoring, and reducing food waste. The intelligent packaging system will help the parent company to comply with ongoing trends and newest technologies, which will help them stay competitive in the market and make significant contributions to the packaging sector.

We selected a packaging company (parent company) that is leading the global food market with its continuous revolutionary technologies, as well as a biosensor company, HID Global, that has a diverse variety of markets in the government, corporate, education, and healthcare sectors. Our idea will open a new market for both companies.

A leading food processing and packaging solution company is Tetra Pak whose headquarter is situated in Switzerland. Ruben Reusing first founded this company which supplies processing, packaging, and thrilling machines for various food products. Some of their tools include cap applicators, conveyors, crate packers, film wrappers, heat exchangers, aseptic processing systems etc. They also provide a comprehensive carton packaging choice for consuming fresh products, which will aid in enhancing performance, reducing costs, and preserving food safety. Their goal is to provide the food and beverage sector with safe, innovative, and environmentally sound solutions. Additionally, they have already produced a smart packaging system for the company Rauch, which is a European fruit juice producer. Tetra Pak have introduced QR codes on cartoons of fruit juices of orange, pineapple, and apple in collaboration with Appetite Creative which is a web-app based solution. Purchasing behaviors, product preferences, average engagement duration, age, location, scan rate, number of visitors, return visitors, and social media shares, all of which include GDPR-compliant personal data have been provided by the new web app provided by the QR code on the package(Tetra Pak). We have produced an innovation for them which aligns with their present business ideas, provides their targeted customers, and will bring a smart new packaging technique for them with dairy products like milk and yogurt. To produce the new packaging system, Tetra Pak requires a new alliance with a biosensor company. We have chosen a biosensor company named HID Global, an American

biosensor manufacturer company. They have a wide range of products and services for physical identity and access management, mobile access, and real-time location services in healthcare. But they do not have any products for the packaging or food industries. This is the sector where HID can bring a radical change to their prevailing services. At present they are flourishing smart cards, mobile IDs, passports, fingerprint readers, facial recognition, RFID technology, and active low-energy Bluetooth. As the company is servicing their products in Asia, Europe, America, and they also bring trust through their products and services, our innovation might help them to hit the market with a sustainable solution (HID Global).

2. Opportunity Recognition

When a company wants to innovate its business model, it must recognize new opportunities and target its resources. Opportunity recognition can be defined actions that a company makes to identify opportunities. Because of rapid changes in the markets and customer demands companies need new opportunities to succeed and survive in the markets. Opportunity recognition helps companies to find changes in the market demands and customer needs. Companies can increase their sales with successful opportunity recognition (Guo et al., 2016.) Sometimes crises can be an opportunity and accelerate innovation in companies (Geurts et al., 2022).

Food loss and food waste are huge global problems that occur in distinct phases in the food supply chain. These cause serious consequences on food security, environment, and economy (Ganeson et al.,2023.) One-third of edible products are lost every year. This has created a major financial problem for the food industry (Schaefer & Cheung, 2018.) Also, a huge amount of food is thrown out when it passes its expiration date. Unfortunately, discarded food is often still good to be eaten. Especially dairy products, meat and fish that end up in the trash when the expiry date is passed (Kafyeke, 2016.) The massive food waste is a huge problem because World's population is growing. It is estimated to be 9 million by 2050 (Ganeson et al., 2023) The food waste and loss also do not help the current hunger crisis. It is estimated that 783 million people will suffer hunger in 2023 (action against hunger 2023).

Lately the food industry has begun to show more interest in packaging development. The aim for this is to store food products efficiently and minimize packaging waste and provide high quality products and longer shelf life. Competition in the food industry also drives companies to develop techniques to improve customer services. New types of packages are intelligent packaging, active packaging, and smart packaging. Intelligent packaging includes indicators, sensors and data carriers that can monitor conditions in the packaging (Dirpan et al., 2023.)

Intelligent packaging technology was commercialized in the 1980s, but the market for intelligent packaging is growing very slowly, under 2 % annually. On the other hand, the interest of intelligent packages has grown in the research field. There have been a lot of publications about intelligent packaging, and many promising materials have been researched for use in intelligent packaging applications (Young et al., 2023.)

Intelligent packaging could be a part of a solution to reduce food loss and food waste (Ganeson et al., 2023). Intelligent packaging can be defined as packaging that can monitor the condition inside of the packaged food or the environment that is around the food with this feature the intelligent packaging system enables

monitoring the food quality improving the food safety, traceability, and identification. The aim of intelligent packaging is creating a stable communication between packaging and the food product (Drago et al. 2020.) The feature of the packaging also gives consumers more information and awareness to prevent intentional and unintentional food waste (Ganeson et al., 2023.)

To prevent unintentional food loss, customers should know when the food has expired. One way to achieve this is to add gelatin tag biosensor into food packaging (Kafyeke, 2016). Biosensors can identify and measure metabolites produced by biochemical reactions (Drago et al., 2020). Innovation's goal is to reduce unintentional food loss. The innovation is needed because expiry date is only an indication of the minimal date of durability. So many products are still good after the date has passed. Many consumers do not want to take a risk, especially dairy products, meat, and fish, because eating these spoiled products can cause very unfortunate consequences. A gelatin tag that can simulate real solvability would solve this problem. The gelatin tag is a combination of four different layers (Picture 1). Gelatin is in the middle, and it resembles the biological structure of the product and its preservability. Under the gelatin is a plastic sheet with indentations. These layers are between plastic films. The gelatin is solid when the product is good, and consumers cannot feel the dents under the sticker. When the food expires the gelatin layer dissolves and dents can be felt and the consumer knows not to eat the product. Gelatine is very similar to animal protein and can be modified to match individual decay rates of food products. This innovation would also be extremely helpful for blind and visually limited people (Kafyeke, 2016.)

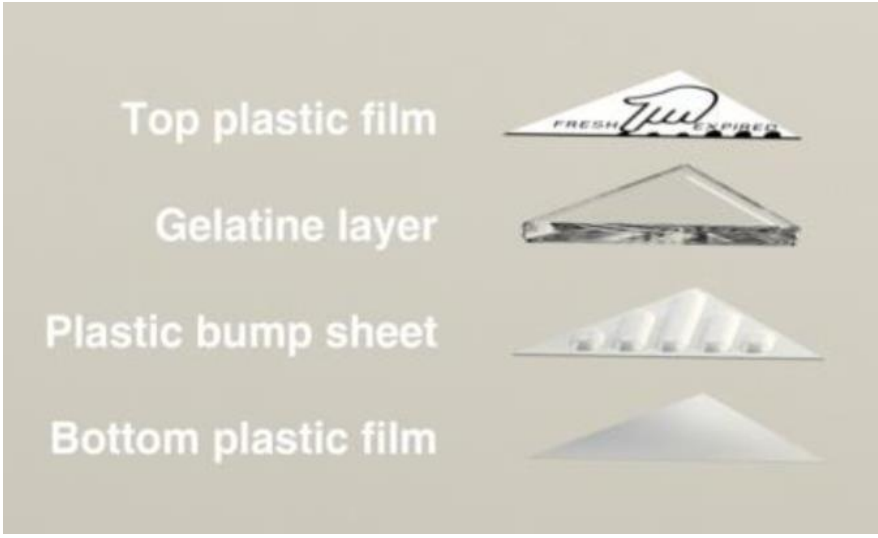

Figure 1 Layers of gelatin tag

Two major things that affect innovation are technology-push and demand-pull. Technology-push means action that aims to increase technology supply, for example funding for R&D. The demand-pull on the other hand refers to action that will boost innovation markets (Hoppmann et al., 2021.) In this case gelatin tag innovation offers the technology and global crises have created the demand for innovation that will decrease food loss.

The biosensor intelligent packaging innovation is executed by Tetra Pak, a world leading packaging solutions offering company. Tetra Pak is a global company, and it sells its products over 150 countries. It has the potential as a company to develop intelligent packages based on the knowledge that they already have connected packages (Tetra Pak). Knowledge on connected packages helps because intelligent packaging is an "upgrade" from connected packages. The connected packages enable interaction between customer and packaging (Ganeson et al., 2023). Tetra Pak's connected packages increase traceability, more product information, and new ways to interact with customers. Tetra Pak enables interaction by adding scannable codes into packages. The codes are a way to increase sales and customer loyalty. For example, the customer can win prizes by scanning the code. Concurrently data can be collected from consumers. The second way to utilize codes is to track and trace the location and history of the product. Tracking products provides improvement for quality control and supply chain transparency. Also, tracing the product's history and location enables monitoring market performance and spotting potential errors. Also, retailers get the same benefits from their perspective. Tetra Pak also has an interest in developing intelligent packaging in the future (Tetra Pak.) That leads to the fact that Tetra Pak has a lot of knowledge about packages and packaging industry. They also probably have some background information of intelligent packages because they tend to develop those in the future. All this knowledge and information is useful when thinking about developing intelligent packaging with biosensors.

To make this innovation step possible Tetra Pak needs a partner. The collaboration in this case is valid because Tetra Pak has no knowledge of making biosensors. A strategic alliance with HID Global reduces the cost of innovation when Tetra Pak does not have to make the biosensors. The alliance also reduces risks and developing time. Because of the need for external resources, this innovation process is open. Open innovation allows companies to explore external knowledge and use that to achieve competitive advantage. Interaction with other companies increases the chances to have a successful innovation (Zhang et al., 2023.)

Intelligent packaging with biosensors creates solutions for many global problems such as food loss, food waste and hunger. With the help of gelatin tag customers will eventually save money because they do not

waste good food anymore. This feature gives more value to the packaging and makes packages more accessible for visually impaired people. Considering all these things there is a need for this kind of product in the markets. On top of the customer benefits the Tetra Pak company also benefits from the innovation because it improves the company's image and value from the customer's perspective. This innovation also fits with the company's strategy which is focusing on food safety and quality, sustainable transformation, integrating and optimizing customer operations and innovation growth (Tetra Pak). Intelligent packaging innovation is supporting the innovation growth, food quality and safety and integrating and optimizing customer relationships. The intelligent packaging innovation would be radical to the Tetra Pak company. In this case the innovation is radical because it makes radical changes to already existing products and Tetra Pak does not have any intelligent packages in the market currently (Tetra Pak.) Besides that, intelligent packaging is a very radical innovation specially in European markets because currently intelligent packages are far behind foreign markets compared for example Japan and USA where this kind of products are widely commercialized. One of the main reasons that prevents these new packaging technologies from spreading in Europe is the strict legislation. One of the main challenges of biosensors is to attach biological components to the receptor and avoid interaction between food and biological components (Drago et al., 2020.)

3. Finding the Resources

3.1 Business Model

The term "business model" refers to a company's approach to making money including a list of the products and services the business plans to provide, its value proposition, customer base, and any estimated expenditures. Our intelligent packaging system's business plan is to provide a comprehensive solution that combines sensor technology into packaging for milk products. Different aspects of our business model are depicted as follows and described in the light of the business model canvas (Murray & Scuotto, 2015).

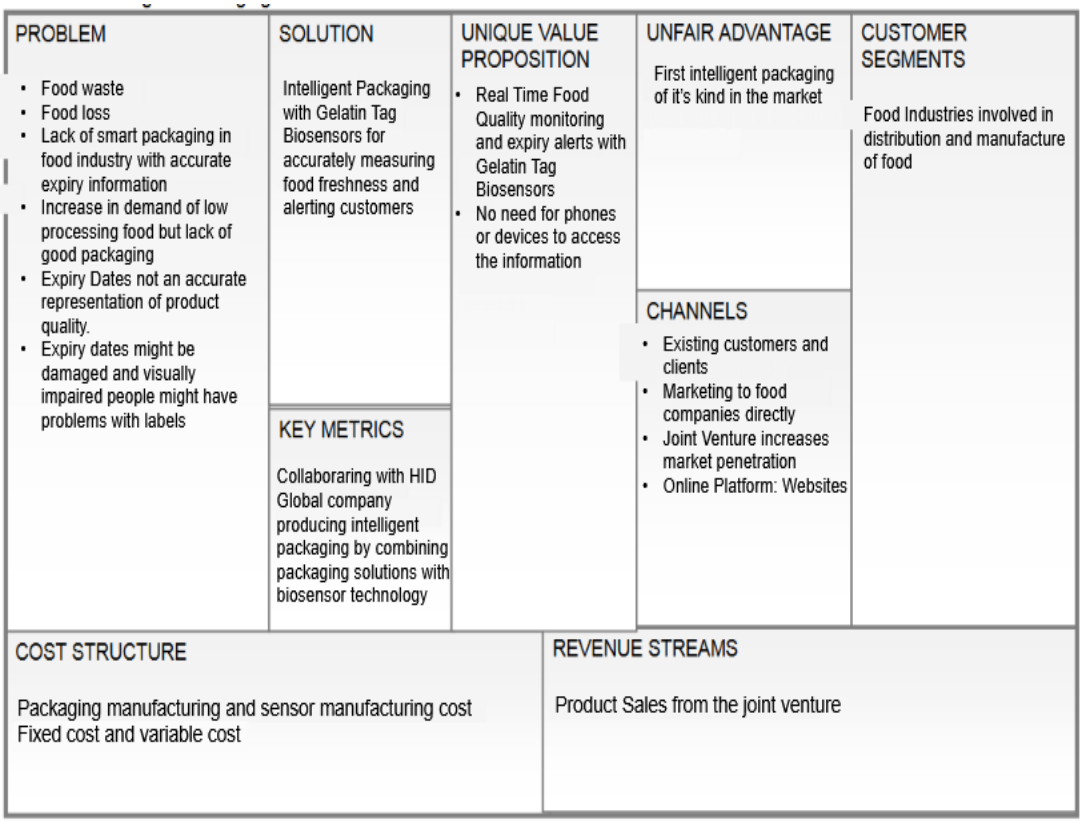

Figure 2 Business model of Intelligent Packing

3.1.1 Key Partner

For our purpose, we are utilizing alliances with HID Global to gain access to resources and knowledge that are not available within our own organization and form reliable and efficient vendor relationships to provide a steady and economical supply chain for the required sensor parts. Through this connection, the innovation idea and worth can be strengthened in the market by improving its visibility, credibility, and reputation

through association with a reliable partner. Because we will provide packaging solutions and HID Global will provide sensor technology, the brand value will improve. Additionally, we can gain access to innovative data analytics tools and connectivity options that complement our intelligent packaging technology by collaborating with IT businesses. Currently, Tetra Pak works with the International Dairy Federation and the Global Dairy Platform (GDP) for transitioning and development of sustainable dairy practices. By taking part in the Ellen MacArthur Foundation's Big Food Redesign Challenge, Tetra Pak work together with stakeholders such WBCSD's Food & Agriculture pathway to decrease food loss and waste. Tetra Pak is also increasing the scope of Food for Development initiatives with important institutions like the Food and Agricultural Organization of the United Nations (FAO) to guarantee access to healthy nourishment.

Motivations for Partnerships stem from risk reduction by pooling resources related to manufacturing, distribution, and market volatility. Also, Economization and Optimization factors are considered, and cooperation attempts to minimize expenses for all supply chain participants by streamlining procedures, streamlining operations, and cutting expenditures are made. By granting access to networks, technology, and specialized resources that may not be accessible internally, partnerships improve an organization's overall capabilities and market reach.

3.1.2 Key Activities: (L/O)

The fundamental tasks an organization must complete to successfully offer its value proposition. Our production tasks involve ongoing innovation and advancement of biosensor technology utilizing gelatin tags, scaling up the production of biosensor-embedded intelligent packaging and quality control (Wang, 2022). And problem solving requires analyzing data to precisely assess the freshness of food items involves processing the information gathered by biosensors. In addition to this, we may utilize algorithms developed by HID Global to analyze biosensor data and give customers precise expiration information.

3.1.3 Key Resources

The underlying resources and assets needed by a company to function and give value to its target markets. Tetra Pak delivers many physical resources, including modern production facilities and packaging expertise, and intellectual assets in design innovation and materials research. In addition, HID Global provides intellectual resources in the form of cutting-edge biosensor technology, which enables exact data monitoring. Tetra Pak's strong financial support and market presence complement HID Global's unique solutions, guaranteeing sufficient resources for R&D and production. As cash resources, the joint venture also has capital investments (Aloysius, 2002).

Intellectual resources include technology, patents, and brand awareness. Human Resources, on the other hand, comprises R&D people, production personnel, and sales and marketing workers. The joint venture would combine Tetra Pak's skilled packaging and manufacturing personnel with HID Global's experts in biosensor technology, fostering a dynamic collaboration poised to develop intelligent packaging solutions with accurate freshness checks and alert systems, powered by a fusion of their combined physical, intellectual, financial, and personnel resources (Dinu, 2016).

3.1.4 Value Proposition

The distinctive value of a product or service stems from its capacity to fulfill consumers' needs and solve their problems. It explains the advantages of choosing a certain product over competitors for customers. The exact value offer is accurate expiry alerts for guaranteed food freshness & real-time quality monitoring to notify customers when product quality deviates. This is so that the products are not consumed past their expiration.

Integrating our packaging with an alert system (Alshannaq & Yu, 2021) for precise expiry notifications not only enhances the quality and reliability of our customers' products but also amplifies their brand value significantly. By incorporating our technology, they gain a competitive edge, offering consumers a cutting-edge solution that ensures product freshness and safety. This advantage not only fosters consumer trust and loyalty but also sets our customers apart in the market, positioning them as industry leaders committed to delivering superior quality and enhanced user experience. This technological advancement will propel customers ahead of competitors and solidify their reputation.

3.1.5 Customer Segments

For our invention, the Customer Segments that we wish to address are key consumers looking for correct freshness or validity information. Tetra Pak now provides processing equipment and packaging solutions to a diverse variety of clients in the food and beverage supply chain (supermarkets, grocery stores, and other institutions) to ensure the safe and effective handling of perishable commodities. In this case, our efforts to reduce food waste might be highly beneficial to present clients who are looking for reliable guarantees about the safety and quality of goods.

3.1.6 Channels

Channels are methods employed to present a company's value offer to potential customers through invention's sales, marketing, and distribution. Tetra Pak's website, in-store food displays, and its array of modern channels—online chat, website FAQs, and dedicated helplines—are excellent ways to reach new

customers, as they frequently value information on packaging and relevant product benefits. Because they have a larger customer base and fewer operating costs than traditional businesses, online retailers may offer lower prices.

3.1.7 Cost Structure

The most expensive operations for our system are biosensor integration into packaging, high-quality material manufacture for intelligent packaging, and purchasing specialist biosensor parts. Waste is reduced; therefore, value is raised even at the sacrifice of additional value. Bulk production may result in a reduced total cost (Sokolov et. al, 2009). There may be costs in the future as manufacturing increases and technology is used for other uses.

3.1.8 Revenue Streams

The strategies used by a business to generate revenue from its diverse customer base and monetize its value offerings, including sales, subscriptions, licensing, and so on. In our situation, product sales are the source of revenue. Currently, depending on their preferences and available payment options, customers purchase food products without explicitly paying for freshness indicators. Through our invention, customers will pay for things like less food waste and dependable freshness information.

3.2 Potential Funding Sources

Adapting our pitch and financing strategy to our innovation aim is crucial if we are to successfully gain profit for our intelligent packaging solution. For our system, internal funding such as personal resources or revenues from first sales might be used to finance the early stages of growth. This will demonstrate to prospective investors our commitment to the project while retaining total control over it. Profits from such sales may then be used to support more sales. The combined resources of the collaborating firms usually provide the funding for a joint venture. The two companies will not only share funding but also will share resources, skills, or technology in accordance with the terms specified in the contract, establishing the venture's financial base (Aloysius, 2002). This might be giving directly to the enterprise, contributing to pooling already-existing resources to help with running the business (Hsueh & Yan, 2011). Two companies can also share profits and risks equally so that the burden falls on everyone involved, not overwhelmingly harming just one company. Additionally, the project's earnings from the joint venture itself can be reinvested, providing a self-sustaining source of capital. Through this arrangement, the firms combine their financial resources to develop and advance the joint venture, reducing the need for outside funding (Wright et al., 2004) and promoting a win-win relationship.

3.3 Strategic Alliance

A strategic alliance between two or more organizations is defined as an agreement to exchange resources or information that may benefit all parties involved (Trott, 2017). For our system, we will create a strategic collaboration with HID Global in the form of a joint venture to pool resources (Hsueh & Yan, 2011) and jointly develop and market the intelligent packaging system. The major reason for this strategic relationship with HID global is its simple expansion into new markets, which in our case is the intelligent packaging system with real-time freshness checks. This might also improve the sustainability and performance of our intelligent packaging solution. Collaborative initiatives are based on pooling individual skills and assets to achieve a common goal (Wright et al., 2004).

Extensive research and development, specialized knowledge, a substantial time and financial commitment, and the possibility of resource diversion and market entrance delay are all necessary to develop an internal biosensor for our intelligent packaging system. Having a joint venture with HID Global has several benefits. We can quickly develop and introduce our product into the market by utilizing their well-known sensor technology knowledge and their established market presence (Koh, 1991). With HID Global's specialized knowledge, we can reduce development costs and ensure a competitive edge through a mutually beneficial partnership (Dinu, 2016). This collaboration not only speeds up our entry into the biosensor segment, but it also allows us to concentrate our efforts on improving the core functionalities of our packaging system.

Our collaboration will enable for Customer Base Cross-Pollination and market expansion (Kogut & Venkatraman, 1991). HID Global has customers in businesses like technology, security, and authentication. Tetra Pak, on the other hand, offers packaging-related services. By providing biosensor-equipped packaging, the two companies will be able to provide their present clients with a new, innovative choice. Customers searching for advanced sensor technology who discover Tetra Pak’s intelligent packaging as a fit for their needs may do the same, increasing both organizations' client bases.

By equally sharing the risks and profits, joint ventures allow two businesses to work together on a particular project or commercial venture in parallel for obvious benefits. They share financial risks, which reduces individual exposure because both businesses bear the burden of losses jointly. When the initiative succeeds, revenues are allocated in accordance with prearranged agreements, guaranteeing that the endeavor is advantageous to both organizations (Dinu, 2016).

A successful joint venture is Sony Ericsson (previously known as Sony & Ericsson), which was founded when Sony and Ericsson combined their respective areas of expertise in electronics and telecommunications. Sony gains access to Ericsson's market supremacy, infrastructure network, and

handset technology. Sony's expertise in consumer electronics, elegant designs, and production techniques might assist Ericsson. As a result, the joint venture strengthens Ericsson's R&D and compensates for Sony's tiny market share (Sigurdson, 2004). Through this joint venture, Ericsson's telecom technology and Sony's entertainment components were combined to develop innovative mobile phones. The alliance resulted in a strong market presence and numerous popular mobile devices (Ohlsson & Odelj, 2007). Similarly, our joint venture can provide a cutting-edge intelligent packaging solution and a significant market presence. Together, the resources, abilities, and skills of these partnerships can open doors to markets or initiatives that would be challenging for any company to undertake independently. Collaborating and delegating responsibilities to separate companies can mitigate individual risk and enhance the project's chances of success.

Joint ventures include benefits such as shared risks and resources, but they can also have drawbacks. One of the hazards connected with our situation is a collision between firm cultures and management styles, which might lead to disagreements over strategy orientation or sluggish decision-making (Zhao et al., 2013), (Shen et al., 2001). Synchronizing operational processes may potentially impose efficiency and effectiveness problems (Dinu, 2016). Furthermore, profit sharing entails foregoing personal rewards, which may not be compatible with our company's long-term financial goals (Luo et al., 2001). Furthermore, both firms will share responsibility for failures and legal difficulties.

4. Developing the Venture

4.1 Product Development Model

Tetra Pak and HID Global together adopt the New Product Development (NPD) process. New product development (NPD) can be defined as "the activities of the firm that lead to a stream of new or changed product market offerings over time. This includes the generation of opportunities, their selection and transformation into artifacts (manufactured products) and activities (services) offered to customers, and the institutionalization of improvements in the NPD activities" (Loch & Kavadias,2011). NPD starts with identifying the opportunities to convert ideas into the product, testing, and finally launching in the market.

In this case, Tetra Pak, with experience and knowledge in food packaging, and HID Global with expertise in biosensors worked together combining technologies, processes, and market opportunities to create products of economic value. The NPD follows a well-structured model which divides the process into different stages. For a successful NPD, the key elements were to identify customers, identify the problem, generate ideas to meet the requirements, develop a product concept, product design, development, testing, and finally commercialization.

The first and crucial part is ideation. A multidisciplinary group was formed between different departments to brainstorm ideas. Since product development success depends on consumer and current market needs, feedback, and the result of the general survey from existing clients were taken into consideration. After reviewing the problem, different ideas were formulated to close the gap. Next major step was screening ideas to ensure primary objectives and consumer expectations with NPD were met. According to Huang et al. (2020) careful evaluation and appropriate methods must be utilized to grab innovative opportunities. Conducting further market research, SWOT analysis, trend, and customer demand developing intelligent packaging with gelatin tag to bridge the gap occurring in the food industry started.

After successful planning, the next step was concept development where a clear framework was designed to meet the desired result. However, to develop packaging that would detect freshness of food inside and communicate the information to the consumer requires outlining technical aspects of packaging and sensor along with marketing considerations. For this purpose, expertise from both companies came together forming an intradisciplinary team and the concept for intelligent packaging began. With a clear vision of the final product, the team began to design the prototype of intelligent packaging and large-scale repeatable tests under various conditions were conducted to ensure the functionality and reliability of the product. The design was continuously refined and modified with identification of issues and problems.

To gauge the customer responsiveness in the market initially, a market test was done before commercializing the intelligent package. This was done by introducing intelligent packaging to limited clients and different situations in processing, marketing, and response in the market were analyzed. Upon success in market testing, full-scale launch proceeded.

This NPD process was done by joint effort from interdisciplinary teams, with good leadership, pre-defined roles and responsibilities and transparent communication, process, and progress. According to Kazmierski and Grębosz-Krawczyk (2017) in each NPD stage, effective communication and collaboration is required between different functional departments as R&D, marketing, production to achieve success which aligns with our joint venture for NPD.

4.2 Factors Influencing Adoption and Diffusion of Intelligent Packaging

Adoption is the process where an individual/ customer begins to use the product. It is a crucial factor for determining the success of the innovation. According to Rogers (1976), the choice to purchase and utilize new products depends on awareness about the product, interest of customers, value evaluation, successful trial and finally adoption. For intelligent packaging, consumers as well as food industries are interested and aware of the value it has to offer in the market. So, the adoption for our product highly depends on successful market testing by different industries for them to adapt it commercially. And it would automatically interest other new markets and clients.

Diffusion is the amount of time it requires for new innovations to be adopted. According to Peres et al. (2010) social factors affect penetration of products or services in the market and determine impact of innovation on collective behavior in the market. The factors affecting adoption rate for the intelligent packaging are described below:

I. **Relative Advantages**: Since intelligent packaging for food industries is not commercially available on the market, it would benefit the company as the product has comparative advantages over traditional packaging. Real-time information on freshness benefits our customers and their end customers by boosting brand value and providing food safety respectively.
II. **Compatibility**: The intelligent packaging material has a lot of potential in food industries and it can be adopted easily. With increasing popularity of clean labels and minimal processing, to assure food safety, customers need to change traditional to intelligent packaging (Li et al., 2020). This demonstrates the compatibility of our innovation in the market. The use of intelligent packaging serves advantage to food industries thereby, increasing compatibility of the innovation.

III. **Complexity**: The technology of intelligent packaging offered is user-friendly, easy to implement and requires minimal-to-no training, it can be adopted easily. According to Scott et al. (2008) complexity is a level of difficulty perceived by customers regarding use and understanding processes. For food industries, adoption of intelligent packaging does not require change in their existing plant, system, and process. Since transition from traditional to intelligent packaging can be smooth, resistance towards change decreases and increases adaptability.

IV. **Communicability:** Since Tetra Pak and HDI Global both have partners and existing clients respectively, it would be easier to communicate with the audience. The interdisciplinary team already experienced in the individual market with networking has a favorable advantage. However, a good marketing strategy should be formulated by the team.

V. **Social factors:** social media influencers and good advertisement through mass media and individuals, can affect adoption of the product. The marketing team are required to develop positive media perception along with addressing concern, product related problems within industry and consumer to achieve successful diffusion.

The result of a survey conducted by Li et al. (2020) showed the public's positive attitude towards the concept of intelligent packaging where majority consumers were neutral about traditional packaging, but rest of the customers showed dissatisfaction clearly indicating the need of intelligent packaging in food industries. With collaborative teamwork and an already existing network increases adoptability of the developed products. Nevertheless, clear understanding of customer needs, strategic communication, simplified design and displaying good marketing approaches need to be employed to gain early adopters. Likewise, remaining consistent after an early adopter might increase the visibility of innovation in the market and hence attracting early majority and late majority.

5. Creating Value

In the global knowledge economy value creation is the process of generating additional value and benefits that creates monetary, environmental, and social value with the innovation of new products or services for customers, stakeholders, and broader economy.

An intelligent packaging system helps create a value perspective in the customer segment and for the company. It helps to reduce food wastage, aiding in savings, keeps the freshness of the product and visually attractive makes the product more attractive to draw customers. It also helps to reduce consumption of natural resources for example, temperature and humidity monitoring with the help of intelligent packaging, in fresh foods helps prevent unexpected changes in ingredients, microbial growth and resource waste (Vira). Again, the use of barcodes, RFID (radio frequency identification) and digital biological markers gives the information on the manufacturing date, expiry date and storage condition of food which ensures the product quality and safety of the food products (Vira).

5.1 Value Creation through Intellectual Property Protection

Faisal Santiago defined the Principles of Intellectual Property as a property right that is the result of inherent intellectual ability of humans. He categorized it as a right to wealth, taking into consideration intellectual property such as knowledge, art, literature, and technology and these require time, energy and cost sacrifice (Santiago, 2017). The use of modern technology in intelligent packaging to monitor and improve the state of packed products needs IP protection. IP protection through its trade secret strategy ensures safeguard and prevents copying of the technology.

Our idea will be kept as trade secrets which are viewed as confidential. We can protect our innovation by keeping the manufacturing process, software, and data processing development secret through licensing agreements. This will increase the product's marketing and boost revenue streams for the parent company.

A trade secret is defined as information, knowledge, formula, techniques, methods or any new ideation that is confidential and advantageous for a company or an individual in running their business. This has advantages over trademarks, patenting or copyright that rely on secrecy to preserve their confidentiality, which need to be registered with government bodies within a set amount of time (Santiago, 2017).
When it comes to technical or non-technical information or managerial knowledge, trade secret protection is seen to be more beneficial than patent protection forms. This is because trade secrets have finite lifetimes and can be extensively advertised because of the patent office registration process. Regarding this, the Trade

Related Aspects of Intellectual Property Rights Including Trade in Counterfeit Goods Agreement (TRIPs-GATT) has established its own protocol for concealed information.

Trade secrets include processes, systems, workings, or intricate information that might be used advantageously in a business venture like ours. Only our company should be aware of our trade secrets to enhance commercial goals and therefore we should hide the technical details or implementation strategies of our innovation. To stop employees from possibly misusing such information, we may create an agreement mandating the employee to keep the secret and not use it for ourselves or others.

To protect our innovation, we chose to keep it as trade secrets. Investors often like to invest in a type of foreign investment which has no interaction with external elements to protect the trade secrets. According to them, trade secrets must have sufficient protection and IP rights in general to decide whether to invest or not (Santiago,2017). Investors often like to invest in a type of foreign investment which has no interaction with external elements to protect the trade secrets.) With this type of protection, we will be able to think more creatively and comply with advanced technology. Infringement on trade secrets will make us suffer as innovators financially. With globalization, trade secrets are becoming crucial with great economic value and fair-trade competition (Santiago,2017).

It is essential to keep our innovation as trade secret, register it, and provide a license in compliance with current regulations to protect the creation from unapproved copyright and to keep the idea confidential. These endeavors will impact the sustainability of the innovation and establish robust market awareness for further developments. All these IP protection protocols will make our innovation more valuable and distinctive in the market.

6. Knowledge Management

The new product design or improvement in the segment requires collection and integration of knowledge which leads to innovativeness (Kamasak & Bulutlar, 2010). In the emerging global scenario, we can observe the evolution of the concept of Knowledge Management (KM) in different disciplines with various perspectives (Jashapara, 2011). Knowledge is the state having access to information, knowing and understanding the information and applying expertise. Likewise, Knowledge Management (KM) is about management of intellectual capital. KM refers to the effort to create, organize and share knowledge in an organization. Knowledge Management refers to identifying and leveraging collective knowledge in an organization to help the organization compete (von Krough 1998 p.137). The transition in the global business perspective comes with new opportunities and trends. The interest in knowledge management by the business is observed largely due to its potentiality to improve the business objectivity and profitability with the improvement in customer satisfaction that could offer varieties of preferences for them with the possibility of extended resources.

The contemporary organization has successfully integrated smart manufacturing and became a veteran in the field. Business has to prioritize and transform their objective. The foundation of the new Learning Organization is now built through Knowledge Management in Tetra Pak after the implementation of intelligent packaging has already been well established with a long journey of providing sustainable and economical solutions to the food and beverage industry. Tetra Pak has again an advantage over their competitor. To gain an unparalleled advantage against competitors the company will have a gigantic amount of potential data in the supply chain, the advantage of previous customer retention with the business and decade of understanding in enhanced customer experience that could be beneficial for future usages. The connected workforce and smart factories around the globe could be utilized for product and services transformation in future. The journey seems unreal without the expertise in the workforce, deliberate customer service and leading external partnership.

Knowledge has potential to drive the transformation and innovation in the organization. The different types of knowledge gained in the organization helps to provide sensible effort and improve the cognitive dimension in the organization. Tacit Knowledge which refers to personal learning, experience, insights and intuition which means it is a knowledge, skill and abilities that an individual gains through experience. The innovative product “intelligent packaging” will allow us to generate Tacit knowledge as well. This pioneer product will create relationships and collaboration between different stakeholders to understand about health and well-being of the people and society, as the intelligent packaging will help to migrate the population and stakeholders to a zone of safe and secure way of consumption. It will also enable us to discover the biodiversity value with the help of packaging because the concept to preserve our ecology is

committed with the modernization in processing and packaging. Further, it will also discover effective ways to forage the acquaintance into policy. The future policies and guidelines are built for utilizing the competitive advantage in future. The knowledge preserved in this stage allows the policymakers to gain advantage over others. This product shall also help to preserve and build a new environmental space and safeguard the greenspaces. Also, this new innovative packaging will contribute to solving the differentiation for the designers and analyze the consumer behavior in order to gain ideas for future reference. The popularization of the concept brings competition and rivalry in the business that can only be tackled with the help of knowledge gained from past experiences.

Similarly, Explicit Knowledge is information that can be documented, stored and shared around the individuals. This type of knowledge can be utilized as a resource to others because it can be accessed, reviewed and processed. Various explicit knowledge can be generated with the help of intelligent packaging. First, explicit knowledge in intelligent packaging products can be derived by the technology and engineering in the product. This information regarding the design of the product, development and functionality of intelligent packing technologies includes details about the sensor which can also provide us with explicit knowledge. Another knowledge we gained in this intelligent packaging is Data and Analytics that involves data collected by intelligent packaging such as temperature, freshness indicator and traceability information which will help to avoid the misunderstanding between the team members during the next R&D process with its reference. It helps in creating sustainable business and widespread processing, production and distribution of the product. Further, innovative products also derive knowledge regarding materials used in packaging and their properties that will help to maintain improved customer service and objectify the business ethics among the employees by preventing the errors and improving the credibility towards the product and business. Documentation of this knowledge can be done through various user manuals such as operational manual, product manual etc. likewise, we can also communicate the stored knowledge through knowledge management system, training programs to transfer both tacit and explicit knowledge among employees. This will ensure to get the right work done through documentation of policies and procedure of the intelligent packaging.

In the process of competing Tetra Pak focused on knowledge creation and management strategy through codification. Codification means an effective way to learn from experience and improve the development of new products and services (Seidler-de Alwis & Hartmann, 2008; Ruggles & Little, 1997). The company is focused on knowledge creation because it is a major solution for their sustainable growth. Nonaka suggested four different processes that could lead an organization to a new level of knowledge creation. He argues that creation of knowledge can only be achieved through social and collective processes (Nonaka, 1994). He suggested understanding and supporting different processes for the creation of new knowledge

in the organization. The processes suggested by Nonaka in the model is Socialization which means to create a new tacit knowledge from the existing tacit knowledge; Externalization, which refers to conversion of tacit knowledge into new explicit knowledge; Combination, that means creation of knowledge from the piles of explicit knowledge that different individual gained throughout the time and the final element Internalization process refers to the reverse method of knowledge creation through conversion of explicit knowledge into tacit knowledge. The above spiral process has benefited Tetra Pak's rising business to the peak.

The parallel development of science and modern business concepts has forced major changes in business collaborating with science and technology. The concept of intelligent packaging is emerging especially in the highly perishable goods. The use of intelligent packaging could benefit the supply chain process of the industries dealing with such types of perishable items. This nanotechnology is equally important for the preservation of ecology and consumer awareness. The technology is beneficial for environmental protection and promotion along with the reduction of wastage. Intelligent packaging could create a win-win business strategy for both businesses and the whole ecology. Intelligent packaging is used to detect pathogens or any contamination. These nanochips aid in the improvement, distribution and quality maintenance during the lifetime of the product. The intelligent packaging helps to improve the quality and enhance the packing properties.

The concept of knowledge creation is adopted from the intelligent packaging in the ongoing product of Tetra Pak widens the opportunity to lead globally for the protection against environmental hazards and promotion of the consumers health through the intelligent packaging. The SECI model of knowledge creation is reflected in this collaboration process as it satisfies the Socialization process discussed by the SECI model suggested by Nonaka and his colleagues. Likewise, another process of knowledge management concept i.e. Externalization is satisfied with the intelligent packaging in Tetra Pak by any leading intelligent packaging making company and integrating them to Tetra Pak's producing and processing unit. Hence, both companies can work for the new era in the packaging and processing industry and roll the innovative product in the market with the benefit of Patent for another decade of making the business successful with science and innovative technology. Another two elements of this model combination and Internalization are systematically applied as the new concept in the organization to create explicit knowledge and then generating new tacit knowledge during the implementation and practical production phase. This is an ongoing knowledge management program for Tetra Pak's business to sustain in future with science and technology.

The intelligent packaging business widens the spectrum to build signal conversion mechanisms and transform the business idea to protect environmental and health hazards and promote pathogens free edibles

to the consumer. This idea can generate more revenue for the business of Tetra Pak and scale the business extraordinarily well with the stark improvement in the segment. This concept will produce technology-driven Knowledge Management and help in codification strategy for the business in future. The food industry along with the packaging and processing industry gets benefits in terms of packaging, processing and long-term storage of the perishable material. The use of nanochip technology in this case helps to improve the taste and texture, and provides information of the state of food inside as well as nutrition facts can be obtained. Further, intelligent packaging helps to detect foodborne microorganisms inside the package and helps to avoid pathogens in the host/consumer.

Hence, we can conclude, the integration of nanochips based models to the Tetra Pak helps to expand the business in collaboration with science and technology. The old fascinating packaging will sooner or later go out of practice/business due to increasing health hazards and environmental degradation. The current vulnerability in packaging and processing of perishable goods, especially the food packaging, requires transducers to convert the material inside the packaging to produce measurable signals in order to avoid hazards with this proactive approach. The innovative product basically produces a wide range of knowledge for future references including an implementation of practical ideas, collaboration of conventional and creative thoughts and provides opportunities to practice in the real business. The application of intelligent packaging to the Tetra Pak helps in quality monitoring, contamination dictation, shelf-life prediction and authentication and traceability. Moreover, the knowledge and learnings from this innovative project can be institutionalized and then it could be integrated and experimented with in future. Knowledge management is regarded as the foundation of organization learning which involves strategies and practices for future usages. Hence, knowledge management will serve to develop intelligent packaging systems for the future perspective and be a suitable concept for learning organization through gaining experience and using that experience.

7. Summary and Conclusion

Food loss and food waste have created serious problems to food security, environment, and economy. One major problem that is causing the food waste is inaccurate expiration dates in the products. Expiration dates are only directional and don't provide facts for the customers. The solution for this problem is an intelligent packaging with gelatin tag biosensor which can provide food quality monitoring in real-time. Our innovation of an intelligent packaging system which is made with gelatin tag does not require any use of smart phones and there is no need of producing any data processing system. With the use of gelatin tag alone, consumers can feel the dents which will help them to know when not to eat the product. This innovation will help the consumers know accurately when the food product has expired. On top of that impaired and disabled people like blind or visually limited persons can identify the expiry of the food product without reading or using any device.

To make this innovation possible Tetra Pak has a strategic alliance with HID Global. The HID Global will provide the biosensor technology while Tetra Pak provides packaging technologies. The alliance will improve brand value and the developing process will be faster and cheaper with a partner which has specialized knowledge. The partnership also allows sharing risks and profits which will reduce financial burden for both companies.

Because the innovation is radical and intelligent packages aren’t available in European markets the product has comparative advantages over traditional packaging which helps the innovation diffusion. The gelatin tag technology is also very user-friendly so it can be adopted easily. The intelligent packaging is also very compatible because it doesn’t require any extra actions to customers or end-users to be used.

In conclusion, our innovation is radical for the Tetra Pak company and for the entire packaging field. It provides value for its target customers which are food and beverage companies that want to provide their customers intelligent features. This innovation improves customer companies' value and possibly their sales and gives them an advantage compared to other food and beverage companies.

8. References

Aloysius, J. A. (2002). Research joint ventures: A cooperative game for competitors. *European Journal of Operational Research*, *136*(3), 591-602.

Alshannaq, A., & Yu, J. H. (2021). Analysis of EU rapid alert system (RASFF) notifications for aflatoxins in exported US food and feed products for 2010–2019. *Toxins*, *13*(2), 90.

David Klift (2018). Copyright Protection for Creative Product Packaging https://www.packagingstrategies.com/articles/90863-copyright-protection-for-creative-product-packaging.

Dinu, A. M. (2016). International expansion through joint venture risks and benefits. *Knowledge Horizons. Economics*, *8*(1), 139.

Dirpan, A., Hidayat, S. H., Djalal, M., Ainani, A. F., Yolanda, D. S., Kasmira, Khosuma, M., Solon, G. T., & Ismayanti, N. (2023). Trends over the last 25 years and future research into smart packaging for food: A review. Future Foods, 8, 100252. https://doi.org/10.1016/j.fufo.2023.100252

Drago, E., Campardelli, R., Pettinato, M., & Perego, P. (2020). Innovations in Smart Packaging Concepts for Food: An Extensive Review. Foods, 9(11), 1628. https://doi.org/10.3390/foods9111628

FutureLearn. Active and intelligent packaging https://www.futurelearn.com/info/courses/how-is-my-food-made/0/steps/63313.

Ganeson, K., Mouriya, G. K., Bhubalan, K., Razifah, M. R., Jasmine, R., Sowmiya, S., Amirul, A.-A. A., Vigneswari, S., & Ramakrishna, S. (2023). Smart packaging − A pragmatic solution to approach sustainable food waste management. Food Packaging and Shelf Life, 36, 101044. https://doi.org/10.1016/j.fpsl.2023.101044

Geurts, A., Geerdink, T., & Sprenkeling, M. (2022). Accelerated innovation in crises: The role of collaboration in the development of alternative ventilators during the COVID-19 pandemic. Technology in Society, 68, 101923. https://doi.org/10.1016/j.techsoc.2022.101923

Guo, H., Su, Z., & Ahlstrom, D. (2015). Business model innovation: The effects of exploratory orientation, opportunity recognition, and entrepreneurial bricolage in an emerging economy. Asia Pacific Journal of Management, 33(2), 533–549. https://doi.org/10.1007/s10490-015-9428-x

HID Global. Powering Trusted Identities of the World's People https://www.hidglobal.com/.

Hoppmann, J., Wu, G., & Johnson, J. (2021). The impact of demand-pull and technology-push policies on firms' knowledge search. Technological Forecasting and Social Change, 170, 120863. https://doi.org/10.1016/j.techfore.2021.120863

Hsueh, S. L., & Yan, M. R. (2011). Contribution-based profit-sharing scheme for joint ventures: Pelno pasidalijimo tarp įmonių schema, pagrįsta patirtomis išlaidomis. *Technological and Economic Development of Economy*, *17*(3), 445-458.

Huang, Z., Ahmed, C., & Gardoni Mickael. (2020). A model for supporting the ideas screening during front end of the innovation process based on combination of methods of EcaTRIZ, AHP, and SWOT. *Concurrent Engineering*, *28*, 2. https://doi.org/10.1177/1063293X20911165

Impacx. What is Smart Packaging: Benefits, Uses and Goals https://impacx.io/blog/what-is-smart-packaging-and-its-benefits/.

Jashapara, A. (2011). Knowledge Management, An Integrated Approach. Pearson Education Limited. 2. Ed.

Kafyeke, T., 2016, Bump Mark: The smart sticker against food waste: green living. https://en.reset.org/bump-mark-smart-sticker-against-food-waste-11302016/

Kamaşak, R., & Bulutlar, F. (2010). The influence of knowledge sharing on innovation. *European Business Review*, *22*(3), 306-317.

Kazimierska, M., & Gręblosz-Krawczyk, M. (2017). New product development (NPD) process – an example of industrial sector. *Management Systems in Production Eng.*, *25*. https://doi.org/10.1515/mspe-2017-0035

Kogut, B. (1991). Joint ventures and the option to expand and acquire. *Management science*, *37*(1), 19-33.

Koh, J., & Venkatraman, N. (1991). Joint venture formations and stock market reactions: An assessment in the information technology sector. *Academy of management journal*, *34*(4), 869-892.

Li, T., Lloyd, K., Birch, J., Wu, X., Mirosa, M., & Liao, X. (2020). A quantitative survey of consumer perceptions of smart food packaging in China. *Food Sci. Nutr.*, *8*(8), 3977–3988. https://doi.org/10.1002/fsn3.1563

Loch, C. H., & Kavadias, S. (2011). Managing new product development: an evolutionary framework. In *Handbook of new product development management* (pp. 1–27). Routledge.

Luo, Y. (2001). Equity sharing in international joint ventures: An empirical analysis of strategic and environmental determinants. *Journal of International Management*, *7*(1), 31-58.

Murray, A., & Scuotto, V. (2015). The business model canvas. *Symphonya. Emerging Issues in Management*, 94-109.

Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization science*, *5*(1), 14-37.

Packaging Europe (2023). Tetra Pak uses smart, connected packaging for better consumer https://packagingeurope.com/news/tetra-pak-uses-smart-connected-packaging-for-better-consumer-engagement/9699.article.

Peres, R., Muller, E., & Mahajan, V. (2010). Innovation diffusion and new product growth models: a critical review and research directions. *Int. J. Res. Marketing*, *27*(2), 91–106.

Ohlsson, C., & Odelj, S. (2007). What happens with company culture when high and low masculine cultures merge? A case study of the joint venture Sony Ericsson.

Santiago, F. (2017). Trade secret protection in the globalization era.

Scott, S. D., Plotnikoff, R. C., Karunamuni, N., Bize, R., & Rodgers, W. (2008). Factors influencing the adoption of an innovation: An examination of the uptake of the Canadian Heart Health Kit (HHK). *Implementation Sci.*, *3*(1). https://doi.org/10.1186/1748-5908-3-41

Schaefer, D., & Cheung, W. M. (2018). Smart Packaging: Opportunities and Challenges. Procedia CIRP, 72, 1022–1027. https://doi.org/10.1016/j.procir.2018.03.240

Seidler-de Alwis, R., & Hartmann, E. (2008). The use of tacit knowledge within innovative companies: knowledge management in innovative enterprises. *Journal of knowledge Management*, *12*(1), 133-147.

Shen, L. Y., Wu, G. W., & Ng, C. S. (2001). Risk assessment for construction joint ventures in China. *Journal of construction engineering and management*, *127*(1), 76-81.

Sigurdson, J. (2004). *The Sony-Ericsson Endeavour: Part I* (No. 04-05). Institute of Innovation Research, Hitotsubashi University.

Sokolov, A. N., Roberts, M. E., & Bao, Z. (2009). Fabrication of low-cost electronic biosensors. *Materials today*, *12*(9), 12-20.

Tetra Pak. Tetra Pak processing and packaging solutions for food and beverages. https://www.tetrapak.com/en-us.

Ulaga, W. (2003). Capturing value creation in business relationships: A customer perspective. *Industrial marketing management*, *32*(8), 677-693

Vira (2023). Smart packaging and its prominent role in environmental protection. https://www.virasmart.co/en/smart-packaging-and-its-prominent-role-in-environmental-protection/.

Von Krogh, G. (1998). Care in knowledge creation. *California management review*, *40*(3), 133-153.

Wang, J., Sun, X., Zhang, H., Dong, M., Li, L., Zhangsun, H., & Wang, L. (2022). Dual-functional intelligent gelatin-based packaging film for maintaining and monitoring the shrimp freshness. *Food Hydrocolloids*, *124*, 107258.

Wright, M., Vohora, A., & Lockett, A. (2004). The formation of high-tech university spinouts: the role of joint ventures and venture capital investors. *The Journal of Technology Transfer*, *29*(3-4), 287-310.

Yam, K. L., Takhistov, P. T., & Miltz, J. (2005). Intelligent packaging: concepts and applications. *Journal of food science*, *70*(1), R1-R10.

Young, E., Mirosa, M., & Bremer, P. (2023). A conceptual model for food industry views on the commercialisation of active and intelligent packaging. Packaging Technol. Sci. https://doi.org/10.1002/pts.2766

Zhang, X., Chu, Z., Ren, L., & Xing, J. (2023). Open innovation and sustainable competitive advantage: The role of organizational learning. Technological Forecasting and Social Change, 186, 122114. https://doi.org/10.1016/j.techfore.2022.122114

Zhao, X., Hwang, B. G., & Yu, G. S. (2013). Identifying the critical risks in underground rail international construction joint ventures: Case study of Singapore. *International Journal of Project Management*, *31*(4), 554-566.