

Impact of Using IoT for Adding Values to Packaged Products

Prof. George Nubar Simonian

**Professor of Digital Printing Dean of the Faculty of Design and Creative Arts Ahram
Canadian University**

george@nubar.net

Prof. Galal Ali Mohamed Sallam

**Professor of Printing Quality and Control Systems the Department of Printing,
Publishing and Packaging the Faculty of Applied Arts-Helwan University**

galalsalam@yahoo.com

Prof. Mahmoud Farouk Elfeky

**Professor of Security Printing Design and Production The Department of Printing,
Publishing and Packaging The Faculty of Applied Arts
Helwan University**

drmahmoudelfeky@gmail.com

assist. Lect. Rasha Fawzy Abdel-Maksoud Ali

**Assistant lecturer The Department of Graphic and Multimedia the Faculty of Design
and Creative Arts Ahram Canadian University**

rashafawzy14@gmail.com

Abstract:

The emerging of modern technologies such as IoT has expanded the meaning of tracking, tracing protecting and marketing. The meaning of tracking in the packaging and labeling industry has changed and become more developed. It means it can follow the Package or label since products are in the packaging stage, until it reaches the consumer hands and beyond. It also includes giving the opportunity for a high quality of after sale services and collecting tremendous data from customers' feedback. Besides, asset tracking inside the packaging plant and tracking the packaging process itself. On the other hand, tracing meaning is for assuring the origin of the product and the origin of its ingredients for authenticating the product; consequently, build the consumer trust in the product itself and in the trademark. Furthermore, IoT has altered the protection process of the product in the packaging industry during storing, handling, shipping, and transportation. It paves the way for monitoring and controlling product's surrounding atmosphere inside and outside the package, for assuring ideal conditions for preservation and storage. It is also to ensure brand protection against counterfeiting. Product marketing, likewise, affected by IoT. It is a new generation of connecting the consumer. It enables brands to offer a new type of consumer experience for the consumer engagement; product and brand intelligence, personalizing communications between consumer and brand, and providing an interactive shopping journey that can begin online and end in the store. Using the IoT in packaging industry has become urgent necessity, but as the all-emerging technologies, there are obstacles confronting its application. The absence of technological awareness among the public, and brand owners and the fear of the ongoing-cost that may be resulted by the use of modern technologies like IoT and printed electronics in the processes of tracking, tracing, protecting and marketing of products are hindrance in front of IoT application. The research study the importance of using IoT technology in tracking, tracing, protecting and

marketing, and three questionnaires were used to conclude the effect of utilizing IoT technology in labels or packages on tracking, tracing, marketing, and protecting, from the view of experts and consumer.

Keywords:

Internet of Things – Track and Trace- Products Marketing- Products protection and authentication – connected packaging- Packaging industry

المخلص:

لقد أدى استخدام التقنيات الحديثة الناشئة مثل إنترنت الأشياء إلى اتساع مفهوم التتبع والحماية والتسويق، فقد تغير معنى التتبع في صناعة التعبئة والتغليف والملصقات وأصبح أكثر تطوراً، حيث أصبح التتبع في تلك الصناعة يعني اتباع العبوة أو الملصق منذ أن يتم تغليف المنتج، حتى يصل إلى يد المستهلك، وأبعد من ذلك حيث يشمل خدمات ما بعد البيع والبيانات الهائلة التي يتم جمعها من تعليقات العملاء الراجعة عن المنتج، إلى جانب تتبع الأصول داخل مصنع التعبئة وتتبع عملية التعبئة والتغليف نفسها. ومن ناحية أخرى بينما يستخدم التعقب في التأكد من أصل ومنشأ المنتج ومكوناته لمصادقة المنتج؛ وبالتالي بناء ثقة المستهلك في المنتج نفسه بالإضافة إلى بناء الثقة في العلامة التجارية. وعلاوة على ذلك، فقد حول إنترنت الأشياء مفهوم حماية المنتج في صناعة التعبئة والتغليف أثناء التخزين والمناولة والشحن والنقل إلى مراقبة الوسط المحيط بالمنتج سواء داخل العبوة أو خارجها، لكي يتم التحكم فيه لضمان الظروف المثالية للحفظ والتخزين. كما أنه يضمن حماية العلامة التجارية ضد التزيف. يتأثر تسويق المنتجات أيضاً بإنترنت الأشياء أيضاً فهو يعد جيلاً جديداً من اتصال المستهلك، والذي يمكن العلامات التجارية من تقديم نوع جديد من تجربة المستهلك من أجل مشاركة المستهلك، وتحقيق المنتج الذكي والعلامة التجارية الذكية، وشخصنة الاتصال بين المستهلك والعلامة التجارية، وتوفير رحلة تسوق تفاعلية يمكن أن تبدأ عبر الإنترنت وتنتهي في المتجر. وبذلك فقد أصبح استخدام إنترنت الأشياء في صناعة التغليف ضرورة ملحة، ولكن مثله مثل التقنيات الناشئة الأخرى، فإنه يواجه عقبات تعرقل عملية تطبيقه، حيث يعد غياب الوعي التكنولوجي بين الجمهور وأصحاب العلامات التجارية، والخوف من التكلفة التي قد تنتج عن استخدام التقنيات الحديثة مثل إنترنت الأشياء والإلكترونيات المطبوعة في عمليات تتبع المنتجات وتعقبها وحمايتها وتسويقها من العوائق أمام تطبيق إنترنت الأشياء، ولذلك يحتوي البحث على أهمية استخدام تقنية إنترنت الأشياء في التتبع والتعقب والحماية والتسويق، واستخدم ثلاثة استبيانات لاستنتاج تأثير استخدام تقنية إنترنت الأشياء في الملصقات أو العبوات على التتبع والتعقب والتسويق والحماية من وجهة نظر الخبراء والمستهلكين.

الكلمات المفتاحية:

إنترنت الأشياء، التتبع والتعقب، التسويق، التغليف المتصل، الحماية

Introduction:

The internet of things (IoT) is a new type of physical communication systems that allow physical objects to collect and share data, so that physical objects and electronic factors can be sensed and remotely controlled across existing network infrastructure. It is enabling integration between the physical world and computer-based systems. It is also extending the use of the Internet into the real world. IoT is known as a combination of physical components and the World Wide Web. Moreover, it is a network of physical objects and embedded electronic functionalities, connected to each other over the Internet. The services provided by IoT applications is based on exchange of sensor data between different things, such as places or devices, etc...

IoT has many applications in smart home, environmental monitoring, medical and health care systems, agriculture, transportation, etc.... IoT is creating a new, connected world full of possibilities; it is an opportunity towards developing packaging industry and products quality.

Research Problem:

IoT technology has not widely been used in adding values of tracking, tracing, protecting, authenticating and marketing to labels and packages of locally manufactured products.

Objectives:

- Study the benefit of using the Internet of Things in each of tracking, tracing, marketing, and protecting in packaging industry.
- Determine the benefits of adding values to labels or packages through using IoT technology to track, trace, marketing, protecting and authenticating products from the viewpoint of consumers, specialists, and workers in production and packaging and specialists and workers in marketing, selling, retailing, shipping, supplying, logistics and trademark owners.
- Check how receptive they are to this new technology.

Methodology:

The study is using the descriptive and analytical approach to explain the importance of using IoT technology in tracking, tracing, protecting, and marketing, and to analyze questionnaires' results to identify the most important opinions of the consumers and experts about issues related to the research subject.

Track and trace:

It is an old and a widely used term in different fields, that generally means in Cambridge dictionary; to follow, using electronic equipment, someone or something that is moving or being transported in order to find out where they are at a particular time. (15) However, there is a slight difference between both terms "track" and "trace".

1. Products Tracking:

Track means following the emerging path forward from starting point to wherever the thing currently is, like tracking the location of a shipped product. While trace means following the completed path backward from its current point to where it began, for example, the country of origin of a packaged product. (5)

In packaging and labelling industry, tracking refers to following the package or label since products are packaged, until it reaches the consumer, through the stages of packaging, storing in warehouses, transporting, shipping and retailing. Moreover, a packaged product maybe post-selling tracked by the manufacturer or brand owner for after sale services and customers feedback. The supplier, manufacturer, marketer, logistics and retailer who are often benefit from tracking process, except in online shopping as consumers are usually tracking their orders across shipping steps.

Track ability gives companies the opportunity to recall a product quickly to contain problems before entering distribution channel. Recalling products rapidly sometimes is vital to protect consumers, even saving lives. Tesco and Mars recalled chocolates over salmonella fears in 2017. (10) In addition to that, it prevents inappropriate distribution of definite products, to

ensure fair and stable distribution network in the market. Although many companies locate the distribution areas according to the distributor, there are a breach of that system. For example, when a distributor offers a product at a lower price to another distributor area. (19)

Inventory visibility is more efficient by track ability; Inventory is one of the most expensive assets in any business, representing up to one-half of total invested capital, needing accurate vision for perfect control and management that cost location, status and reducing its waste. Moreover, tracking offers more timely and accurate upstream and downstream data for all portions of a supply chain. (3)

DHL Group has considered Internet of Things (IoT) technologies in logistics. DHL suggested some ways to rethink packaging in logistics industry in 2020 including, adopting IoT in packaging industry as advancement in IoT can offer greater value to customers while reducing costs and emission to implement tracking potentiality on shipment in transit. (1) Aren Sungjemrenla, Senior Innovation Manager at DHL Asia Pacific Innovation Center explained "IoT allows us to digitize the physical world by attaching sensors to track all the attributes of a shipment, including location, temperature, humidity, shock, and upload it to the cloud," and he added "In logistics; use cases fall within three main areas: Smart operations, transportation, and last-mile delivery." (15)

2. Products Tracing:

On the other hand, traceability is used for assuring the origin of the product and its ingredients, so tracing is related to authenticating the product, protecting against counterfeit and retaining trademark ownership, to build consumer trust in the trademark. Therefore, suppliers and consumers are the sectors that mostly benefit of traceability. (18) Counterfeited products are considered threatening to businesses, causing a financial loss, and have a high risk affecting vital products safety like food and medicine products that may harm lives and environment. Having information on the product through traceability, supply chains can be more confident of legitimate products entering the market, indirectly promoting the consumption of domestically produced products thereby helping in developing the national economy. (3)

3. Tracking the Packaging Process:

Track and trace is a comprehensive process that assuring packaged products quality and monitoring it indoor and outdoor, so it includes tracking the products inside the packaging plant, during packaging process stages, especially with emerging of the "smart factory", besides tracking the process of producing the packages and labels themselves. Until a while ago, it was quite complicated to use IoT with current manufacturing equipment because of traditional systems for expensive upgrades and custom development needed. This has completely changed because of decreased costs, flexible new technologies and specialized companies in IoT and embedded technologies, so it has become easy and of low cost to integrate IoT. (11) Reports on market demand indicate that the market for inventory management and asset tracking solutions is expected to reach \$40 billion in 2027. (16) IoT is expected to affect packaging industries by giving the chance to track and measure every element of their operations, for providing real-time actionable insights through data analytics, by using IoT asset tracking system, communication protocols, networks and cloud environments, to be integrated with

current enterprise systems. It can be used to modify packaging processes for dealing with any appearing issue with the asset in real-time. Its aim is to continue hassle-free production across production lines and better performance, (11) preventing Work-in-Progress accumulation, live monitoring for machine health, continuing cycle time reporting to improve throughput, identifying bottlenecks at key process or transit nodes and improving on-time product delivery to customers. (7) It, consequently, improves the flow of goods from the factory to the entire supply chain and retail system through implementing digital factory and product management. (8) For example, packing scales and process-weighing systems malfunction leads to either under-weighing or over-weighing of the substances, and resulting in loss for the manufacturer. (11)

Choosing the right technology for asset tracking relies on the aim of tracking, the business challenges, and the environment where the solution deployed with range, key factor in technology selection. For outdoor tracking, GPS is applicable technology; however, indoor positioning like in warehouse or supermarket, other technologies like RFID, Wi-Fi, NFC, Bluetooth Low Energy (BLE) and Ultra Broadband (UWB) used for indoor tracking systems. Some of these technologies can accurately track location of assets with accuracy up to centimeters. Technology type is based on asset mobility and movement of assets extension, if restricted to a certain place like a facility or a building, and then short-range asset tracking technologies is used. On the other hand, wide range asset tracking like GPS suitable for moving on a wide area like a district or a city. (16)

Products Protecting:

Protecting packaged and labeled products is packaging primary function against potential damages or destruction during shipping or warehousing. The protection process is through the package material itself like laminated cardboard with polyethylene in food packaging, or by using protective suppliers like inflatable air pillows, bubble wrap, over wrap with shrink film, bundling (film placed around multiple items), foam-in-place, paper dunnage and void fill systems, corrugated die cut inserts, EPS packaging (expanded polystyrene) and polyurethane packaging. (17) Emerging of modern technologies like IoT has expanded the meaning of protection in packaging industry to include monitoring and controlling product surrounding condition for assuring ideal conditions for preservation and storage and brand protection against counterfeiting.

A number of factors drives the anti-counterfeiting packaging market, for instance, developing brand awareness, the huge counterfeit products available on the market, the flourishing e-commerce industry, consumers' awareness of data on the product, the evolution of printing technology, and worries over the effects of counterfeiting. (13) Smartphones are popular media for brand protection via low cost simple technology QR codes and NFC to combat counterfeiting in the point of sale, pushing retailers to ensure preventing counterfeit products from entering the supply chain. This is predicted to be the main barrier to preventing counterfeits. (6)

Products Marketing:

Marketing packaged and labeled products via IoT enables brands to propose a new generation of consumer experience and consumer engagement, smart product and brand, personalized communications between consumer and brand, and interactive shopping journey that begin online and end in the store. Online engagement delivers a customer-focused experience. A customer journey could also include product reservation while online browsing, personalized recommendations, real time promotions, new products checking or online orders, inside the store payment without check out. IoT enables product and brand storytelling and recommendations, post sales services for maintenance, customer services managed via customer mobile, to meet customer demand.

Data gathered through the Internet of Things can be used to forecast market trends, help businesses improve their business models, (8) improving brand loyalty and using gathered relevant information on a target market's behavior, demographics and values to influence the marketing strategy and increase sales. (4) Furthermore, generated data of IoT develops the traditional one-way information process flow from the producer to the consumer, enables mutual interaction between brand, retailer, and consumer. Although the product has been purchased and reaches final user, it still active and generates data that is transmitted back to the retailer or the brand-owner to be analyzed for further improvement. (9)

Retailer and brand owners can benefit from analyzed data of product movement, sales conversion (the conversion of a prospect to lead to a customer), movement in the shop floor in back stock or on the selling floor and money mapping (involving many activities related to money management like understanding income and expenses) by revenue planning and visual merchandising. (12) Visual merchandising is a method for attracting customer's attention and increasing revenue by setting the tone for the brand: The mood or emotion advertising message conveyed to consumers through specific style (2), that the most obvious examples of visual merchandising are seasonal displays in stores. (20) Moreover, retailer and brand owners can make trusted decisions in retail with real time product and customer journeys; determine selling zones based on the performance of the product and customer engagement; and plan showroom with visibility to back stock and real-time availability of products to meet customer demand. In addition, they can acquire customer loyalty by providing visibility for customer through mobile applications to track the item through the whole product journey, and locate the product in production and pre-sell stages to notify a customer with exact delivery time. (2)

Research Work:

The researcher designed three online questionnaires for determining the impact of added values to labels or packages of the products on tracking, tracing, marketing, protecting and authenticating of the products through internet of things (IoT) and printed electronics (PE). The first one directed to consumers in general, the second one to specialists and workers in the field of packaging production and the third one to specialists and workers in marketing, selling, retailing, shipping, supplying and logistics; besides, trademark owners.

Questions are multiple choices (3-7 choices depending on the question, the majority of 3 choices) except some questions that the researcher was keen to know specialists' and individuals' opinions in some points, and left it open to the respondents to add their opinion in

brief if they liked. Every questionnaire consist of two parts: The first part of three joint questions for the three questionnaires: Respondents age, educational level and specialization, which are general information about the respondent and it was mentioned that it would be used only for research purposes. The second part was the target questions with different questions for every questionnaire. The questionnaires second part was of 15 questions for the consumers, 13 questions for both the others. The dissertation supervisors and a questionnaire specialist in Agricultural Research Center revised and approved these questions, and then questionnaires were tested through experimental sample of respondent.

The questionnaires continued open for about one month and a half. They were published via several channels like private messages via WhatsApp and Messenger and in public on Facebook pages and groups. For example, postgraduate studies and scientific research in Egyptian universities group, a number of groups for The Faculty of Applied Arts graduates and students, the group of Dar Al-Manzuma to Help Researchers, etc.; besides, several of the visitors, exhibitors and workers in one of the exhibitions specialized in packaging in Egypt (Print2Pack 2022- printed forms used).

Results:

4. Results of First Part of Questionnaires (joint questions):

The results of the first part showed, that the total respondents for the three questionnaires were 560. They were 400 respondent for the first questionnaire (consumers); 80 respondent for the second questionnaire (specialists and workers in the fields of production and packaging); and 80 respondent for the third questionnaire (specialists and workers in the fields of retails, marketing, logistics, supplying and brand owners and managers).

The majority of the respondents were 41-50 years old. They were 176 respondents (31.4%), then 13-40 years old with 158 respondents (28.2%), 105 respondent of 12-30 years old (18.8%), 72 respondent older than 50 years old (12.9%) and 49 of the respondent younger than 21 years old (8.8%). (Figure 1)

Regarding the educational level, the respondents were 312 (55.7%) with Bachelor degree, 67 (12%) with PhD, 60 (10.7%) with Master degree, 57(10.2%) student, 40 (7.1%) with Diploma, 14 (2.5%) Post Intermediate degree and 10 (1.8%) with Intermediate degree. (Figure 2)

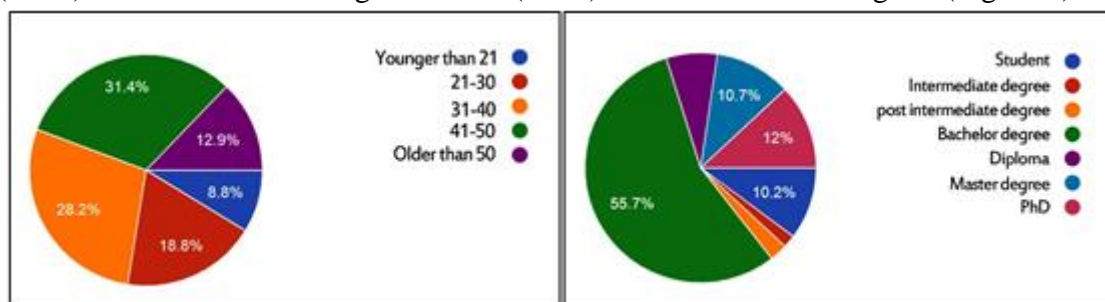


FIGURE 1: AGE OF THE RESPONDENTS

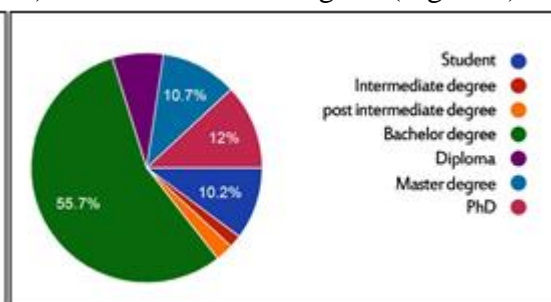


FIGURE 2: EDUCATIONAL LEVEL OF THE RESPONDENTS

2. Results of First Questionnaire for Consumers:

2.1 Question 1:

The results indicate that 66% of this questionnaire respondent prefer both data printed on the packaging or the label, and brand website for getting information about the product; 22.8% prefer printed information and 11.3% prefer using online resources. (Figure 3)

2.2 Question 2:

A percentage estimated by 78% of respondent interested in knowing the origin of the product components and the data related to it, while 17.3% may be interested in it, and the rest 4.7% do not interest at all. (Figure 4)

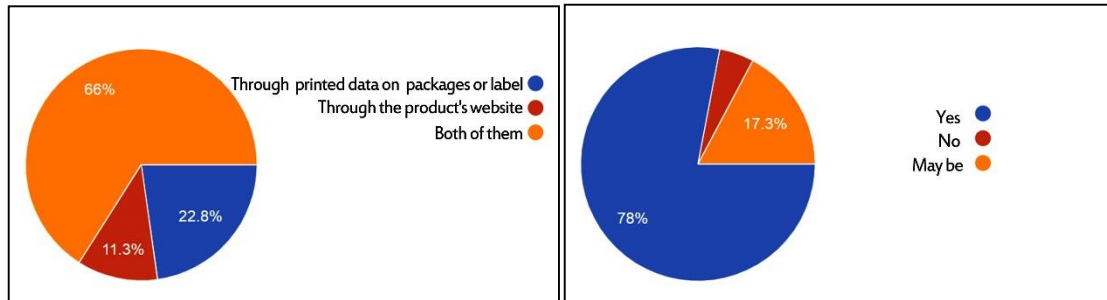


figure 3: preferred method of obtaining product's information

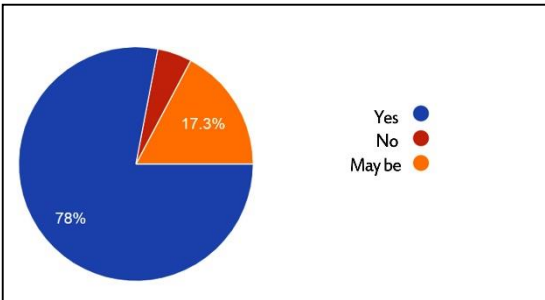


figure 4: wishing to obtain detailed information about the product components

2.3 Question 3:

The majority of the respondent 89.3% would like to have a means embedded in the package to connect directly to the Internet to ensure that the product is original and not counterfeit, 9.3% may like to have this option and 1.5% do not want this ability. (Figure 5)

2.4 Question 4:

The majority of the respondent 80.5% think that all kinds of products need a means for connecting to the Internet for providing detailed information about the origin of the product and its components, and to ensure that the product is not counterfeited. 7.8% think that pharmaceutical products needs this ability, 6.3% of respondent think that food products needs this, 3.3% for beauty and personal care products and 2.2% for industrial products. (Figure 6)

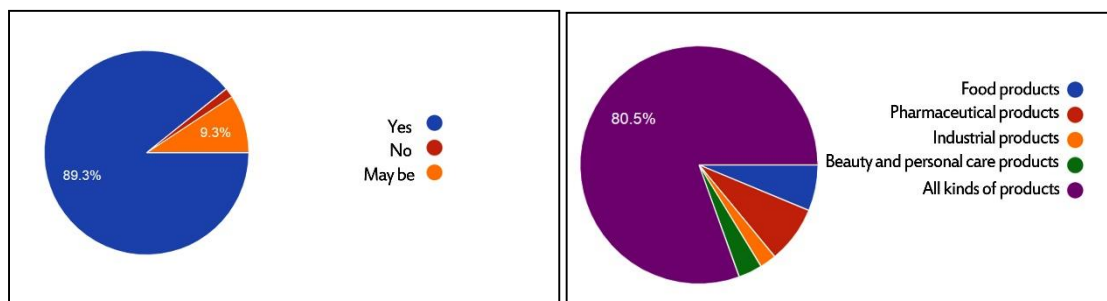


Figure 5: Wishing to ensure the product authenticity via internet

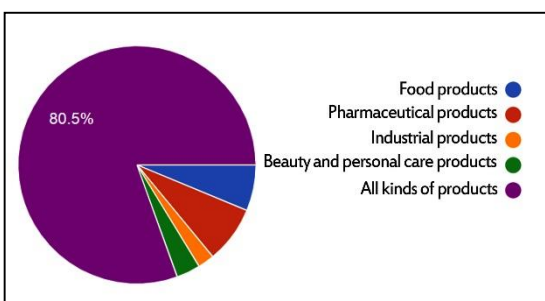


Figure 6: products type need a connection to the Internet for detailed information on product's origin

2.5 Question 5:

A percentage estimated by 76% of respondent would like to have a means embedded in the package for directly communicating with the responsible of the brand to evaluate the product, 19% may prefer to have this option and 5% do not want this option. (Figure 7)

2.6 Question 6:

The majority of the respondent 86.3% think that having a means to track the product via Internet to know the origin of the product and its components to ensure that it meets standards may increase confidence in the national product, while 10.8% not sure of that and 3% think that it does not. (Figure 8)

2.7 Question 7:

A percentage estimated by 47.3 % do agree that brands that they deal with to get personal contact data for sending offers, coupons or promoting their products but via a specific means of communication and 21.2% do agree via any means of communication, while 31.5 % do not agree and consider it a violation of personal privacy. (Figure 9)

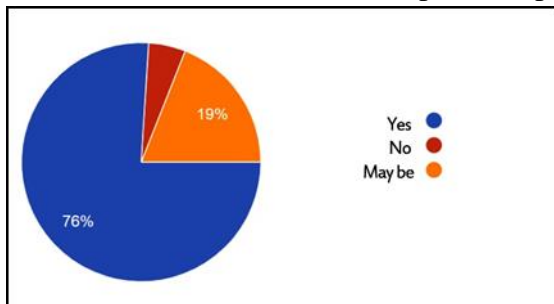


Figure 7: Need direct connection to the brand for evaluating the product

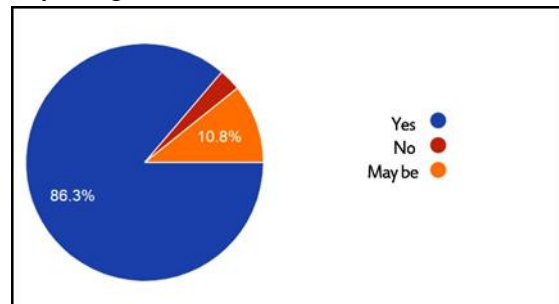


Figure 8: Need tracking means via Internet to know the origin of the product

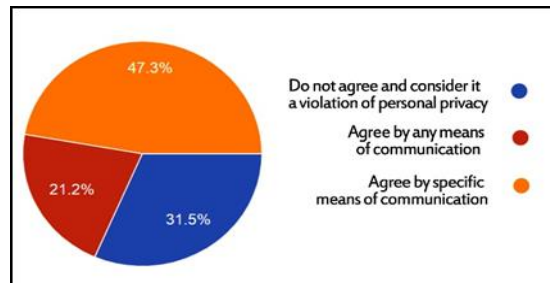


figure 9: respondent opinion on giving personal contact data to the brand

2.8 Question 8:

This question is an open one, 189 person (74.3%) that their answer in the previous question was "agree to give personal contact data to the brand they deal with for sending offers, coupons or promoting their products via a specific means of communication" answered it to mention preferred means for communicating. The answers are mentioned in (Table 1).

table 1: respondent preferred communication method with the brand

Communication Method	Number of respondent
SMS	19
E-mail	63
WhatsApp	46
Mobile phone	15
Messenger	13
Social media (Facebook/Telegram)	33

he results in the table shows that the majority of the respondent prefer email as a communication method with the brand then WhatsApp, social media at third place then messenger was at the last level.

2.9 Question 9:

A percentage estimated by 36.5% of the respondent did not receive a damaged product due to damaged packaging or shipping carton when purchasing online, while 26.5% received a damaged product only once and 20.3% for several times, whereas 16.8% do not buy online. (Figure 10)

2.10 Question 10:

A percentage estimated by 36.5 % do not deal with the same shipping company or the product supplier if the package or the outer carton damaged, 32.3% do not deal if only the product itself

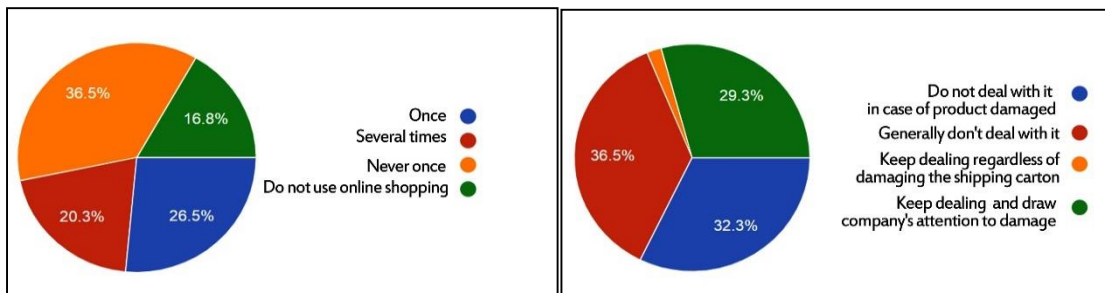


Figure 10: number of times receiving a damaged product due to damaged packaging

Figure 11: The response of the consumer on damage of the package or the outer carton

damage regardless of the package or the shipping box, and 29.3 % keep dealing and draw the company attention to that damage. While 2 %, Keep dealing and do not care about the damage. (Figure 11)

2.11 Question 11:

A percentage estimated by 51.2 % of the respondent do agree to use IoT to enable tracking the number of packages or the quantity of a certain commodity at home, and to automatically order from the supermarket when it falls below a certain limit, 22.5 % said that they might do, while 26.2 % do not want to use this technology. (Figure 12)

2.12 Question 12:

A percentage estimated by 35% prefer to use such modern technologies related to the Internet of packaging and labels and they think it is useful and facilitates daily life, 53.8 % may sometimes use it, at the time that 11.3 % absolutely refuse that. (Figure 13)

2.13 Question 13:

A percentage estimated by 55.8 % do agree to shop in smart stores, which depends on creating an account on the online store linked to consumer's credit card. Then the consumer taking the required products from inside the store and directly exit, with no need to go through points of sale (cashier). 22.8 % may do shopping in that kind of shops while 21.5 % refused to do. (Figure 14)

2.14 Question 14:

A percentage estimated by 69.5 % would prefer to have such smart stores in Egypt, 21.3 % are not sure, if they really want these smart stores in Egypt, and 9.3 % do not want it. (Figure 15)

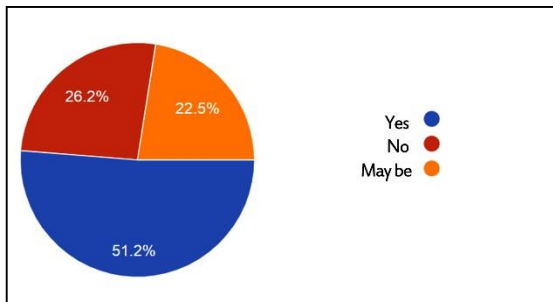


Figure 12: Respondent opinion on using IoT in automatically order from the supermarket

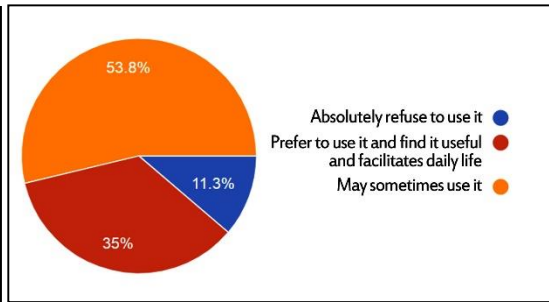


Figure 13: Respondents opinion on using IoT technology

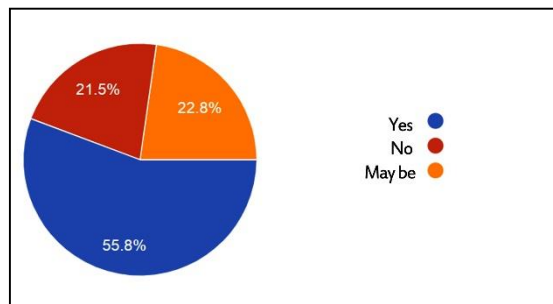


Figure 14: The respondents opinion on shopping in smart stores

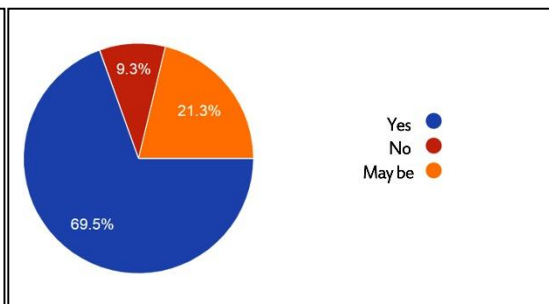


Figure 15: The respondents opinion on having such smart stores in Egypt

2.15 Question 15:

An open question to know the reasons for previous answers in brief. 247 person of the whole respondent of this questionnaire answered this question. (Table 2)

Table 2: Brief reasoning of respondents' answers for the previous question

The respondent opinions	Approximate numbers for similar opinions
Agreeing opinions	
Saving time and effort; Reducing crowding at the point of sale and facilitating shopping.	156
Keeping pace with technological development.	23
Reducing human interaction.	2
Doubtful and opposing opinions	
Fear of paying through bank accounts and visa or credit cards.	16
Lack of sufficient technological awareness among the public.	11
Feeling unsafe and untrusted in general for a number of reasons like fearing of errors and reducing job opportunities.	39

3. Results of Second Questionnaire for Specialists and Workers in the Fields of Production and Packaging:

3.1 Question 1:

The job or profession of this questionnaire respondent as follow: (Table 3)

Table 3: Profession of this questionnaire respondent

Profession/Job	Number of respondent
Working in printing, packaging & production field in general	36
Manager in printing, packaging & production field	14
Professors, postgraduate & graduate of printing and packaging	14
Designers	12
Printing and packaging students	4

3.2 Question 2:

The majority of the respondent 87.5 % need to know accurate, real-time information on the location and condition of the product inside and outside the industrial facility, 11.3 think they may need to know, 1.2 % do not need this data. (Figure 16)

3.3 Question 3:

The majority of the respondent 90 % would like to use modern means to track the product in real time to ensure the quality of production and consumer satisfaction, 6.3 % may use this means and 3.7 % do not want to use it. (Figure 17)

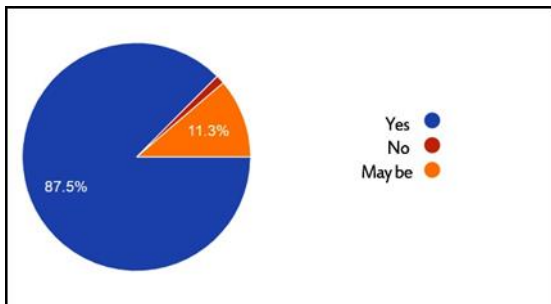


Figure 16: Need to know real-time location and condition of the product

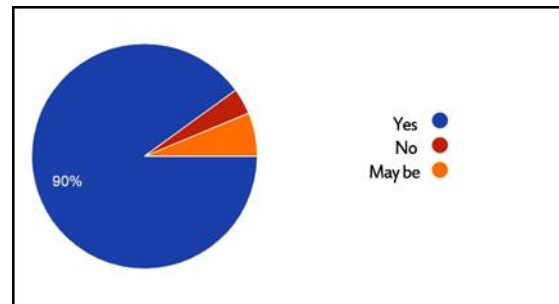


Figure 17: Like using modern means for real time product tracking

3.4 Question 4:

The majority of the respondent 92.5 % believe that obtaining consumer opinion about the product immediately after using it via connected packaging or label would contribute to improve the quality of the product, 5 % think that it may be done while 2.5 % do not think so. (Figure 18)

3.5 Question 5:

The majority of the respondent 87.5 % think that the consumer's connection to the Internet through the package or label achieves consumer protection from counterfeit products circulating in the market and contributes to protect the brand, 11.3 % think that it may be do whereas 1.2 % do not think so. (Figure 19)

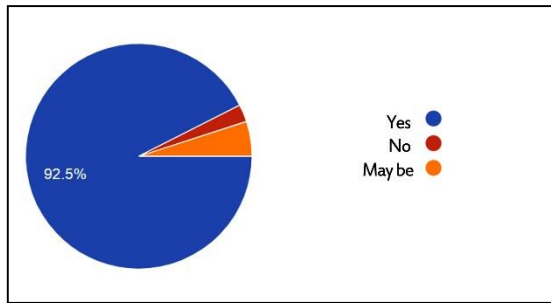


Figure 18: Getting immediate opinion on the product after using improve product quality

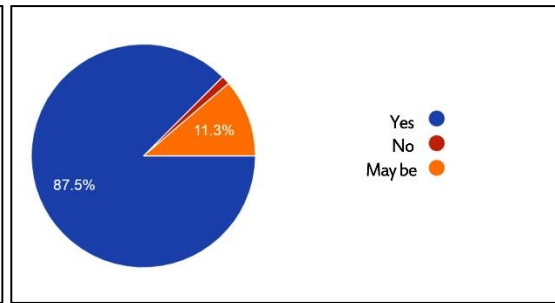


Figure 19: connecting to the Internet through the package achieves protection from counterfeit products

3.6 Question 6:

The majority of the respondent 90 % think that tracking the location of each package accurately in real time through means added to the package helps in easily and quickly recalling the product when an error occurs in the manufacturing process or the product lacks quality, 8.8 % may be done, while 1.2 % think it does not. (Figure 20)

3.7 Question 7:

The majority of the respondent 78.8 % think that collecting and analyzing the data of each connected package or label life cycle from production all the way to the consumer's hand can help decision makers in making the right decision at the appropriate time, 17.5 % think it may do and 3.7 % do not think so. (Figure 21)

3.8 Question 8:

The majority of the respondent 80 % do think that analyzing product tracking data, automatically monitoring packaging process and receiving alert messages in real time would contribute in obtaining a comprehensive view of the production process, improving it and avoiding bottlenecks in operations. A ratio of 18.8 % think it may be done, while 1.2 % do not think so. (Figure 22)

3.9 Question 9:

The majority of the respondent 86.3 % think that tracking and monitoring the product and the packaging process in real time in the factory would contribute to delivery on time and customer satisfaction, 11.3 % think it may be and 2.5 % think it may not. (Figure 23)

3.10 Question 10:

A percentage estimated by 58.8 % think that connected packages or labels technologies would spread in Egypt very soon, while 28.7 % think it may be done soon and 12.5 % do not think it would spread in the near future. (Figure 24)

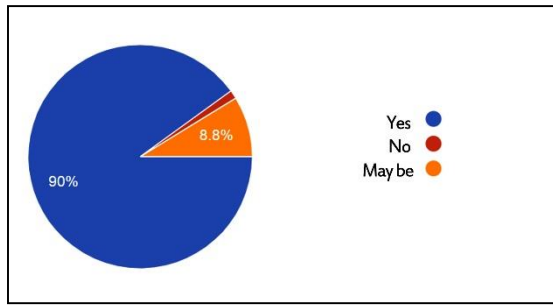


Figure 20: Package location tracking in real time via added technology to package helps recalling the product from the market

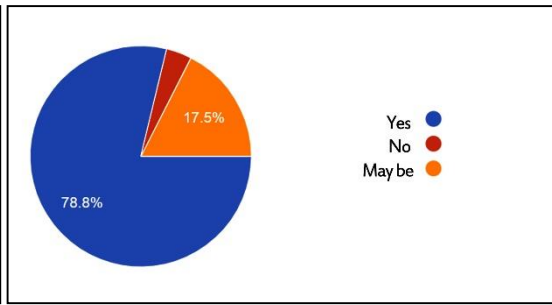


Figure 21: Collecting and analyzing data of connected package life cycle help in making the right decision

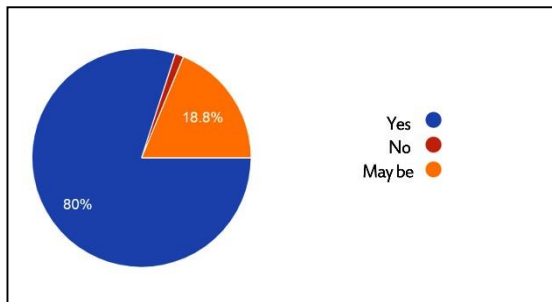


Figure 22: Collecting and analyzing product tracking data gives comprehensive view of the production process

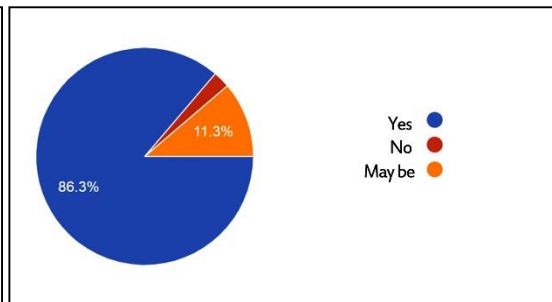


Figure 23: Tracking and monitoring packaging process in real time in the factory would contribute to delivery on time

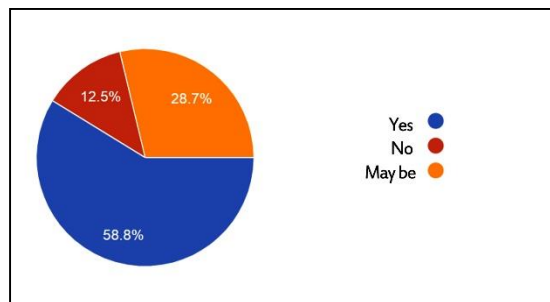


Figure 24: Connected packages or labels technologies would spread in Egypt very soon

3.11 Question 11:

An open question to know the reasons for previous question's answers in brief. A number of 42 person of the whole respondent of this questionnaire answered this question. (Table 4)

Table 4: Brief reason of respondents answer in the previous question

The respondent opinions	Approximate numbers for similar opinions
Agreeing opinions	
Emerging technologies such as the Internet of things, digitalization are to be used and spread, and the packaging industry is one of areas that would gain many benefits of the technological development, besides, Egypt on the way for digitalizing of everything.	21

Track and trace products via connecting them would become a modern trend for preventing commercial fraud, expressing consumers' opinions, and maintaining product quality	4
Doubtful and opposing opinions	
Lack of sufficient technological capabilities and consumer awareness.	11
Worry about the technology on-cost.	6

3.12 Question 12:

The majority of the respondent 80 % think that modern product tracking and tracing technologies added to the packages or labels to know the product origin, its components and the surrounded atmosphere information during its life cycle, would achieve a breakthrough in the quality of products and the packaging industry in Egypt. A ratio of 16.2 % think that these technologies may do while 3.7 % do not think so. (Figure 25)

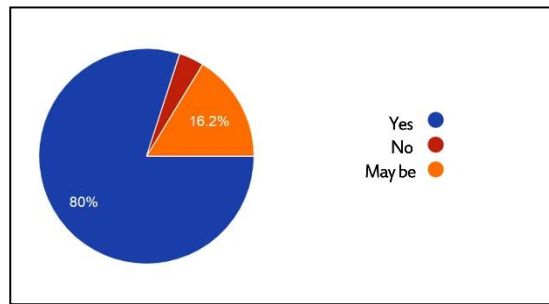


Figure 25: Modern product tracking and tracing technologies would achieve a breakthrough in products quality and the packaging industry in Egypt

3.13 Question 13:

An open question to know the reasons for previous question's answers in brief. A number of 31 person of the whole respondent of this questionnaire answered this question. (Table 5)

Table 5: Brief reason of respondents answer in the previous question

The respondent opinions	Approximate numbers for similar opinions
Agreeing opinions	
To connect the consumer and the brand for ensuring the product authenticity, protection and compliance with specifications, besides, increasing competition between producers for consumer benefit.	15
Products track and trace technologies during its life cycle, would achieve a breakthrough in the quality of products.	7
Modern technologies for track and trace provide a huge amount of data to be analyzed to obtain information for development process of products and industry.	4
Doubtful and opposing opinions	

Doubts about public acceptance of this development and its importance.	4
Worry about the technology on-cost.	1

4. The questionnaire for Specialists and Workers in Marketing, Selling, Retailing, Shipping, Supplying, Logistics and Trademark Owners Results Indicates That:

4.1 Question 1:

The job or profession of this questionnaire respondent as follow: (Table 6)

Table 6: Profession of this questionnaire respondent

Profession/Job	Number of respondent
Sales & retailers	42
Shipping & Logistics	16
Marketing	10
Brand Owners and specialist	8
Business Administration	4

4.2 Question 2:

The majority of the respondent 72.5 % agree that direct contact between brand officials and the consumer through modern technological means in packaging and labels gives the consumer confidence in the brand, 20 % think it may do, while 7.5 % do not think so. (Figure 26)

4.3 Question 3:

The majority of the respondent 82.5 % think that real-time tracking of products that are affected by changes in surrounding atmosphere conditions, such as temperature, whether in warehouses or stores, and sending an alarm message to the official's mobile phone help in reducing wastage and thus minimizing institution's losses. 8.8 % think it may do and the same percentage 8.8 % think it does not. (Figure 27)

4.4 Question 4:

A percentage estimated by 66.3 % of the respondent believe that the consumers would prefer to buy products that have embedded means of connecting to the Internet in packages or labels to get more information about the product than to read the information printed on the packaging, 22.5 % believe they may prefer so and 11.3 % believe they do not. (Figure 28)

4.5 Question 5:

The majority of the respondent 82.5 % prefer to have a method to track stock levels, on the shelves or in the warehouse, to be alerted before running out, and send a direct message to the supplier for a new order, and consequently the purchase movement is not disrupted, 13.7 % may prefer so and 3.7 % do not prefer that. (Figure 29)

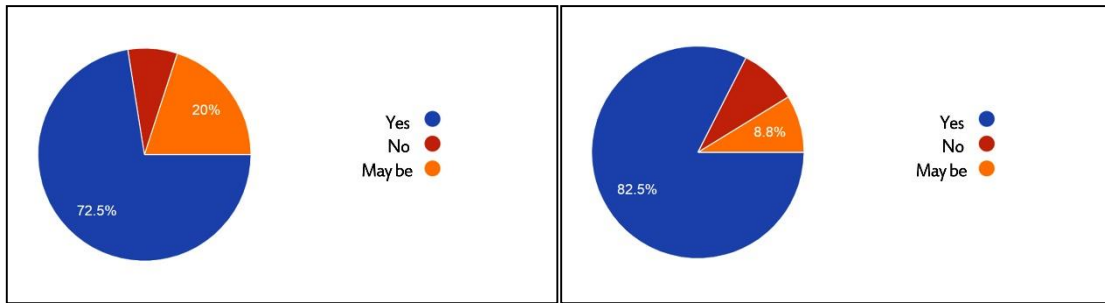


Figure 26: Direct contact between brand and the consumer via modern technological raising consumer confidence in the brand

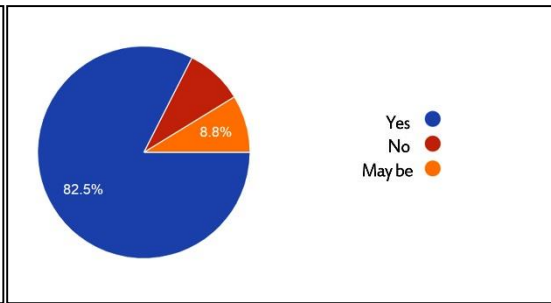


Figure 27: Real-time products tracking and sending an alarm message to the official's mobile phone help in reducing wastage

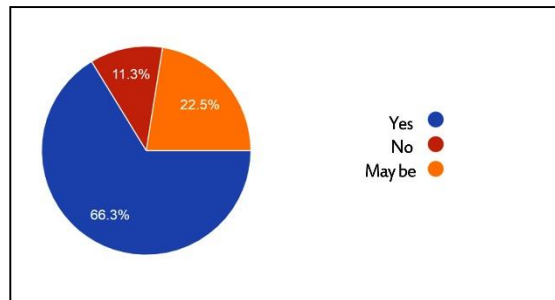


Figure 28: Consumers prefer products with embedded means of internet in packages for more information about the product

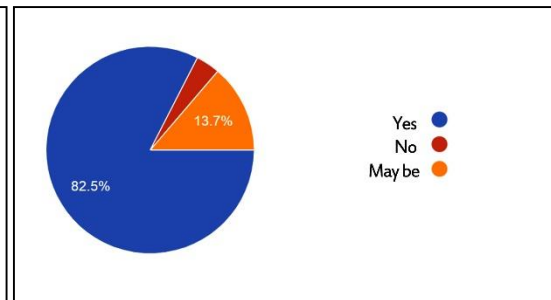


Figure 29: Prefer to have a method to track stock levels, on the shelves or in the warehouse

4.6 Question 6:

The majority of the respondent 83.8 % prefer to have an automated method for monitoring and analyzing the data of sales movement at each point of the store to know the active and passive points of sale and thus reorganize the locations of the products and their displaying for increasing sales. A percentage of 8.8 % may prefer so, while 7.5 % do not at all. (Figure 30)

4.7 Question 7:

A percentage estimated by 65 % think that connecting consumer to the Internet through the package to track and trace the product and ensure that it complies with the specifications would help increasing consumer confidence in the brand and protect him/her from counterfeit products circulating in the market, 21.3 % may think so whereas 13.8% do not think so. (Figure 31)

4.8 Question 8:

The majority of the respondent 75 % believe that connected packages and labels would promote the brand through a direct communication channel between the consumer and the brand officials, 20 % believe it may do while 5 % do not believe that it would do. (Figure 32)

4.9 Question 9:

A percentage estimated by 62.5 % think that connected packages and labels might influence consumer-purchasing decisions, improve product experience and ensure brand loyalty, while 25 % think it may do and 12.5 % do not think so. (Figure 33)

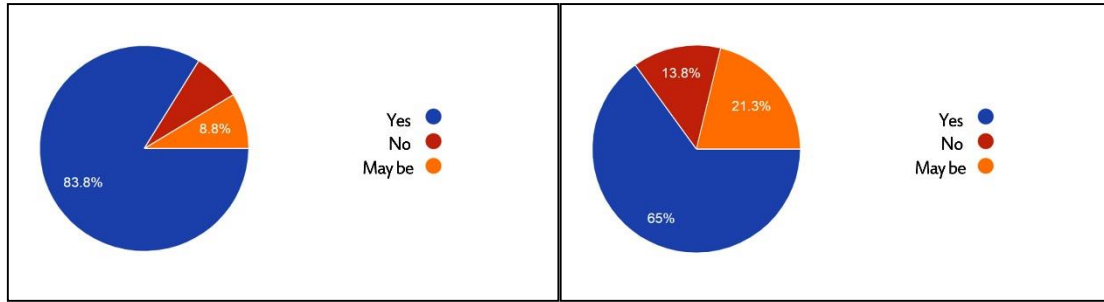


Figure 30: Prefer to have an automated method for monitoring and analyzing sales data to know the active and passive points of sale

Figure 31: Connecting consumer to Internet to track and trace products help increasing consumer confidence in the brand

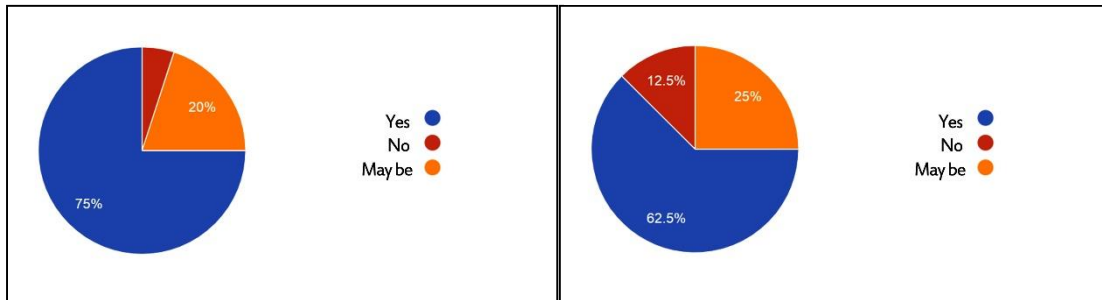


Figure 32: Connected packages would promote the brand through a direct communication between the consumer and the brand

Figure 33: Connected packages and labels might influence consumer-purchasing decisions

4.10 Question 10:

The majority 78.8 % of the respondent do think that obtaining consumer immediate opinion on the product after using through connected packages or labels would contribute to rapidly developing marketing plans of the product and support brand sales, 17.5 % may think so while 3.7 % do not think so. (Figure 34)

4.11 Question 11

The majority 77.5 % of the respondent do think that consumer use of connected packages and labels would be useful in promoting new products and providing quick and easy after-sales services, whereas 18.8 % think may be, and 3.7 % do not think so. (Figure 35)

4.12 Question 12:

A percentage estimated by 56.3 % of respondent think that connecting products technologies through packages or labels would spread in Egypt soon and consumers would like to interact with it, 33.8 of the respondents think may be, while 10 % do not think so. (Figure 36)

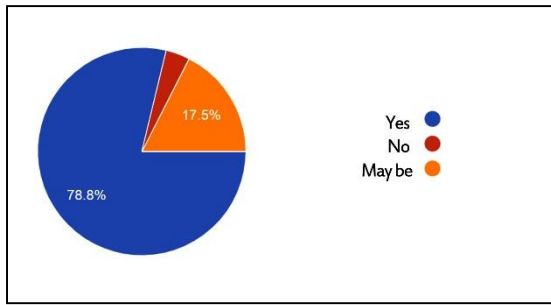


Figure 34: Obtaining consumer immediate opinion through connected packages contribute to rapidly developing marketing plans

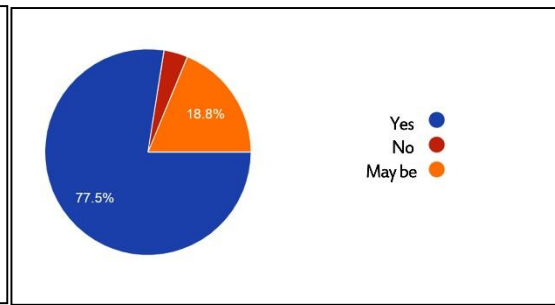


Figure 35: Connected packages for promoting new products and easy after-sales services

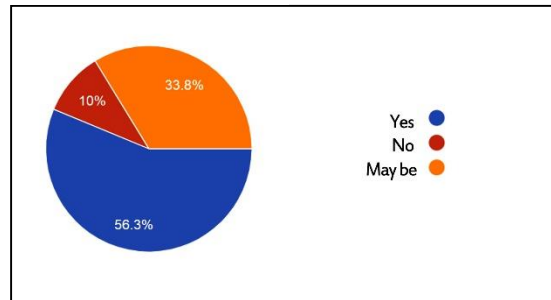


Figure 36: Connecting products technologies would spread in Egypt soon

4.13 Question 13:

An open question to know the reasons for previous questions' answers in brief. A number of 37 person of the whole respondent of this questionnaire answered this question. (Table 7)

Table 7: Brief reason of respondents answer in the previous question

The respondent opinions	Approximate numbers for similar opinions
Agreeing opinions	
Connected packages and labels increases consumer confidence in the brand, offering more info on the product.	14
Connected packages and labels primitively initiated in some products with QR as Egypt tend to use modern technology and digitalization in all fields, in addition, young Egyptians interest in technology.	9
Doubtful and opposing opinions	
The absence of technological awareness among public and technology on-costs.	14

Discussion:

1-The Questionnaire for Consumers' Results Indicates That:

- The printed info is still at the same importance as technological ways for providing data and the technological methods will not completely replace printed packaging and labels.

- Using the IoT for offering the origin and components of all kinds of the product and pay attention to providing consumers with product tracing information has become an urgent necessity in order to assure the authenticity of the product.
- Direct and immediate communication between the consumer and the brand has become one of the necessities of the current times, which is provided by the use of Internet of Things technology.
- Tracking the product via IoT to know the origin of the product and its components to ensure that it meets standards can be a step to increase confidence in the national products.
- The importance of maintaining the quality of product packaging in general and shipping boxes in particular during shipping, transportation and storage operations to ensure customer retention and prevent shipping and logistics companies losses through using modern technologies methods like IoT in tracking shipments.
- The readiness of consumers in the Egyptian society to accept added value to labels or packages through technologies to track, trace, purchase and ensure the product authenticity, despite the fear of many errors, technical problems, piracy operations on bank accounts, and violation of privacy. In addition to the lack of confidence in electronic systems that may result from automation processes and emerging of modern technologies such as the Internet of things and smart stores.

2. The questionnaire for Specialists and Workers in the Fields of Production and Packaging results indicates that:

- The importance of using modern technology in track and trace for monitoring and controlling products through its life cycle to ensure the quality of products and production process, in addition to ensuring consumer satisfaction.
- Using IoT and connecting packages in collecting consumer immediate opinion on the product would contribute to improve the quality of the product through analyzing feedback data and convert it into useful information for decision makers.
- Connecting consumer to the Internet through the package or label to trace the products achieves consumer protection from counterfeit products and indirectly protect the brand.
- Using IoT and connected packages and labels in tracking the location of each package accurately in real time helps in easily and quickly recalling a certain product from the market when an error occurs in the manufacturing process or the product lacks quality.
- Connected packages or labels technologies would spread in Egypt as long as spreading awareness of the importance of adopting such technologies in the field of packaging industry and products quality, also urging development to achieve a breakthrough in the packaging industry in Egypt, especially the initial steps of track and trace is already used in Egypt like QR codes.

3. The questionnaire for Specialists and Workers in Marketing, Selling, Retailing, Shipping, Supplying, Logistics and Trademark Owners results indicates that:

- The importance of connected packages and labels for communicating consumer and brand for retaining existing customers and converting them into permanent ones. It also increase the

level of trust in the brand, giving more info on the product, promoting new products of the brand, quick and simple after sale services, and giving the consumer the chance to verify the authenticity of the product.

- Connected packages and labels indirectly reducing products waste and consequently losses of the businesses through tracking the surrounding atmosphere, and alarm in real-time in case of any defect, in addition to, monitor and control the stock.
- Like the previous questionnaires' indications, the obstacles to the application of these modern technologies is the absence of technological awareness among the public, and brand owners and the fear of the on-cost that may be produced by the use of modern technologies like IoT and printed electronics in the processes of tracking, tracing, protecting and marketing of products.

Conclusion:

Making use of the IoT technology in packaging industry for tracking, tracing, protecting, authenticating and marketing products has become an urgent necessity. Connected packaging is of importance not only for the consumer but also for the brand, marketer and retailer. It offers for all of them immediate data in real-time on the product location and surrounded condition for more protection and expansion of shelf life towards reducing waste and sustainability. It gives the opportunity to be authenticated. It, also, provide detailed data for the consumer on the product, after sale care and offers, through direct connection with the brand. Generally, using IoT in packaging industry would be a radical change in processes of tracking, tracing, protecting, authenticating and marketing but more awareness of its importance is needed.

References:

1. "5 WAYS THE LOGISTICS INDUSTRY CAN RETHINK PACKAGING IN 2020." Web log. DHL (Article). DHL International GmbH, January 2020. <https://lot.dhl.com/5-ways-the-logistics-industry-can-rethink-packaging-in-2020/>.
2. A., Julija. "Engaged Customer Merchandising? Definition and Examples." Web log. SmallBizGenius (Article). SmallBizGenius.net, March 2022. <https://www.smallbizgenius.net/knowledge-base/what-is-visual-merchandising/>.
3. "Benefits of Food Traceability." Web log. Food Safety Magazine (Article). BNP Media, July 2015. <https://www.food-safety.com/articles/4192-benefits-of-food-traceability>.
4. "Consumer Engagement." e Pac flexible packaging. e Pac Holdings, LLC. Accessed May 2022. <https://epacflexibles.com/epacconnect/>.
5. "Difference between Track and Trace." Stack Exchange . Stack Exchange Inc. Accessed March 2021. <https://ell.stackexchange.com/questions/34391/difference-between-track-and-trace>.
6. Ferrante, Maria. "The Power of Smart Packaging." Web log. Baking Business.com (Article). SOSLAND PUBLISHING COMPANY, December 2019.
7. "How Can Asset Tracking Bring Value for You? Track and Trace Parts, Products and Assets for Real Time Optimization." Deloitte (Article). Disclaimer . Accessed February 2021. <https://www2.deloitte.com/nl/nl/pages/energy-resources-industrials/articles/industry40-how-can-asset-tracking-bring-value-for-you.html>.

8. "IoT Solutions." HUAYUAN. SHANGHAI HUAYUAN ELECTRONIC CO.,LTD. Accessed July 2022. <https://www.huayuansh.com/applications/iot-solutions/>.
9. Lydekaityte, Justina, and Torben Tambo. "Connected Stores, Connected Brands, Connected Consumers, Connected Goods: On Business Model Ecosystems in Internet of Packaging." Nordic and Baltic Journal of Information and Communications Technologies Denmark (February 2020) pp 88-89.
10. "Mars Recalls Chocolates over Salmonella Fear." BBC NEWS. June 2017. <https://www.bbc.com/news/business-40226415>.
11. Modawal, Archana. "Transform Your Packaging Factory Using a Smart Factory Solution." Web log. Softweb Solutions Inc (Article). Softweb Solutions Inc, November 2019.
12. "Retail Use Cases Engaged Customer." MOJIX. MOJIX. Accessed April 2022. <https://www.mojix.com/retail/engaged-customer/>.
13. "RFID Tags for Smart Packaging and Logistics Industry." Web log. HUAYUAN (Article). SHANGHAI HUAYUAN ELECTRONIC CO.,LTD. Accessed April 2021. <https://www.huayuansh.com/categories/Article/industry-news/>.
14. "Track and Trace." In Cambridge. Cambridge Dictionary. Accessed April 2021. <https://dictionary.cambridge.org/dictionary/english/track-and-trace>.
15. "TRACK AND TRACE: WHY YOUR BUSINESS NEEDS IT MORE THAN EVER." Web log. DHL (Article). DHL International GmbH, November 2020. <https://lot.dhl.com/track-and-trace-why-your-business-needs-it-more-than-ever/>.
16. "Types of Asset Tracking Technologies Asset Intelligence Series." Web log. Deloitte (Article). Disclaimer & copyright. Accessed January 2021. <https://www2.deloitte.com/nl/nl/misc/search.html?qr=Types%20of%20asset%20tracking%20technologies%20Asset%20Intelligence%20Series>.
17. "The Ultimate Guide to Protective Packaging." USA: Industrial Packaging, n.d.
18. "What Is Product Traceability?" Web log. Holded (Article). holded, November 2019. <https://www.holded.com/Article/what-is-product-traceability>.
19. "What Is Track and Trace? What Are the Benefits for Brands and Manufacturers?" Web log. ADVOTICS (Article). ADVOTICS, April 2021. <https://www.advotics.com/en/track-and-trace-benefits-brands-manufacturers/>.
20. "What Is Visual Merchandising? Definition, Types and How to Use It." Web log. Indeed (Article). Indeed, April 2021. <https://www.indeed.com/career-advice/finding-a-job/what-is-visual-merchandising>.