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SUPPLY CHAIN TRACEABILITY - A MARKET DRIVEN APPROACH

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Abstract:
This research aims to design Total Traceability System (TTS) to join individual food industry's traceability system with more efficiency and more flexible and unchangeable existing data standard and business processes. This research introduced the new concept idea of single and unique identified traceability data, it is called "Traceability Key" (or Trace No). The manufactures, who have individual traceability system and without the system, can use Trace No replacing lot/batch No in order to trace backward and track forward about product throughout supply chain instead using a combination of product code and lot/batch No. As a result, this research aimed to find out main criteria concerned to achieve Total Traceability System and propose new TTS. A result of involved total traceability system by two Thai beef businesses with common product but different standard, both can performed traceability require via internet connection rapidly. In addition both businesses can involve the system with unchanging their existing standard and processes. In addition, this approach is an alternative way to create total traceability system to join individual traceability system with uncommon standard. And it also is suitable for small businesses who lack of knowledge and financial support. Therefore, they can have the traceability system as giant firms.

Keywords: supply chain, traceability system, supply chain traceability system (SCTS), total traceability system (TTS), Gs1 global traceability standard (GTS)

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1. INTRODUCTION

Nowadays Traceability system is considered to be major priority and common tool of food industries and also forced by Regulations. According to horse meat scandal in Europe in February 2013, the prepared meals labeled as beef-based and containing horse meals were sold by Findus Group Ltd. and manufactured at a Luxembourg factory owned by French company Comigel. This affected not only in Europe but also extended around the world because of the logistic of the complexity chain retailers such as Tesco and careful. From the first incident, the first elements of the investigation seem to lead to suppliers in Romania were founded in 48 hours [1]. And then the three-month program of checks was agreed by the 27 EU member states have performed. The 4,144 tests carried out across the EU for the presence of horsemeat DNA, 193 were positive (4.66%)[2]. The scandal led to products worth millions of euros being withdrawn from stores. It has also highlighted the inability of producers to guarantee the ingredients in processed meat products. It is considered that the performance of existing traceability system of food businesses is inefficiency and delays.

In principle, all producers in EU must have traceability system to fulfill regulations. Unfortunately their systems are verity and uncommon standard. Therefore traceability requirement have performed manually by documents and email. In addition more of small and medium food businesses always manage traceability data by hand because of lack of IT investment and knowledge management. Due to the problem, Government should encourage and support Food industries to develop Chain Traceability System (CFTS) or Supply Chain Traceability system (SCTS) for increasing speed of response when incident happen. So this research aims to find out why supply chain traceability system has been introduced slowly in the food sector and propose the approach total traceability database for supply chain traceability system for general industry and uncommon standard. The implementation was implemented in case study with two beef businesses in Thailand.

2. LITERATURE REVIEW

2.1 EU Regulations

2.1.1 REGULATION (EC) 1760/2000 (Beef Labeling Regulation)
In 2000, the European Commission introduced Regulation 1760 / 2000 to ensure that all beef producers labeled that must include the following information:
- the reference number or code establishing the link between the meat and the animal (or group of animals) from which the meat was derived;
- "Slaughtered in" (country where slaughter took place and licence number of the slaughterhouse);
- "Cutting/cut in" (country where cutting was performed and licence number of the cutting plant).
- the country where the animals were born;
- the country where the animals were fattened/bred; and
- the country where the animals were slaughtered.

The aim of the legislation was to ensure that beef in retail outlets could be linked back to the individual animal or the group of animals from which it originated. The BSE crisis of the 1990s caused a decline in beef consumption across Europe and the Commission hoped that with the introduction of this legislation, consumers would regain confidence in beef [GS1 Ireland]

Picture 1: Sample of Beef label followed REGULATION (EC) 1760/2000

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2.1.2 Regulation (EC) 178/2002 (general food safety)

The General Food Law Regulation (EC) 178/2002 is EC legislation on general food safety. The full name is "REGULATION (EC) No 178/2002 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety". The principal aim of the Regulation is to protect human health and consumers interests in relation to food. The main requirements are:

- Food must not be unsafe, i.e. it must not be injurious to health or unfit for human consumption.
- Labeling, advertising and presentation of food must not mislead consumers.
- Food businesses must be able to identify the businesses from whom they have obtained food, ingredients or food-producing animals and the businesses they have supplied with products, and produce this information on demand.
- Unsafe food must be withdrawn from sale or recalled from consumers if it has already been sold.

2.2 Traditional Traceability system concept

According to literature review, Most currently business's traceability data system management were designed under regulation concept of "One step backward and on step forward". This concept is shown in figure 2 and 3 . It mean traceability partner concern only one level of history of raw material and product coming and history of product delivery to customers.

Picture 2: Traditional Traceability System Model
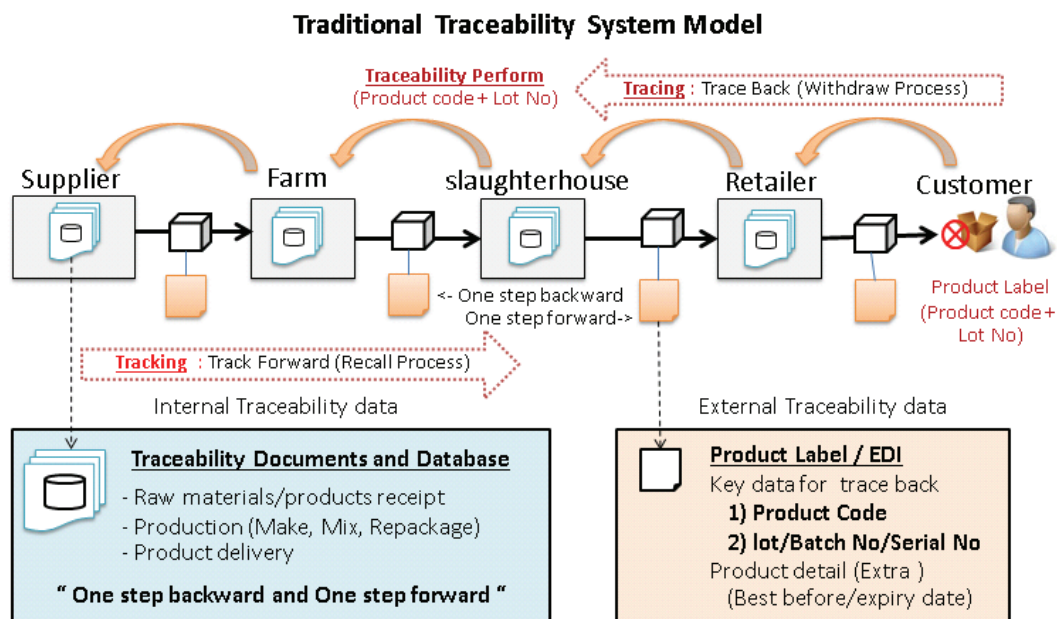
Form Picture 2, each traceability partner have individual traceability database and may apply different standard. Each traceability dataset consist of internal and external data.

2.2.1 Traceability Data management

- Internal traceability data is a collecting of data record and information of raw material , production and product delivery

- External traceability data is a collecting of unique identify data for product unite, normally carried in product label or container, it usually is a compound data such as

    - Product code and lot number of product

    - Product code and serial number

    - Product code and transportation number.

The using data is depend on the type of product and activity. The logistic information is also included. This data will keep in customer's internal traceability data at receipt process at customer location.

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2.2.2 Traceability data processes

There are three traceability data processes in particular processes follow as below:

Inbound receipt item Process: when raw material or finish goods are arrived in, traceable item receipt process is performed by collecting product information (products code and lot of item receipts) and logistic information (When and Where it come from)

- Production Process:
  Traceable data Create process is perform when new lot of products have produced by collection production information (which lot of raw material are used to produce each lot of products)

- Outbound Process:
  Transport Traceable is perform , when sending item to customer , by collecting transportation information (which lot of product is delivered and where is the destination of transportation)

Picture 3: Framework of traceability processes
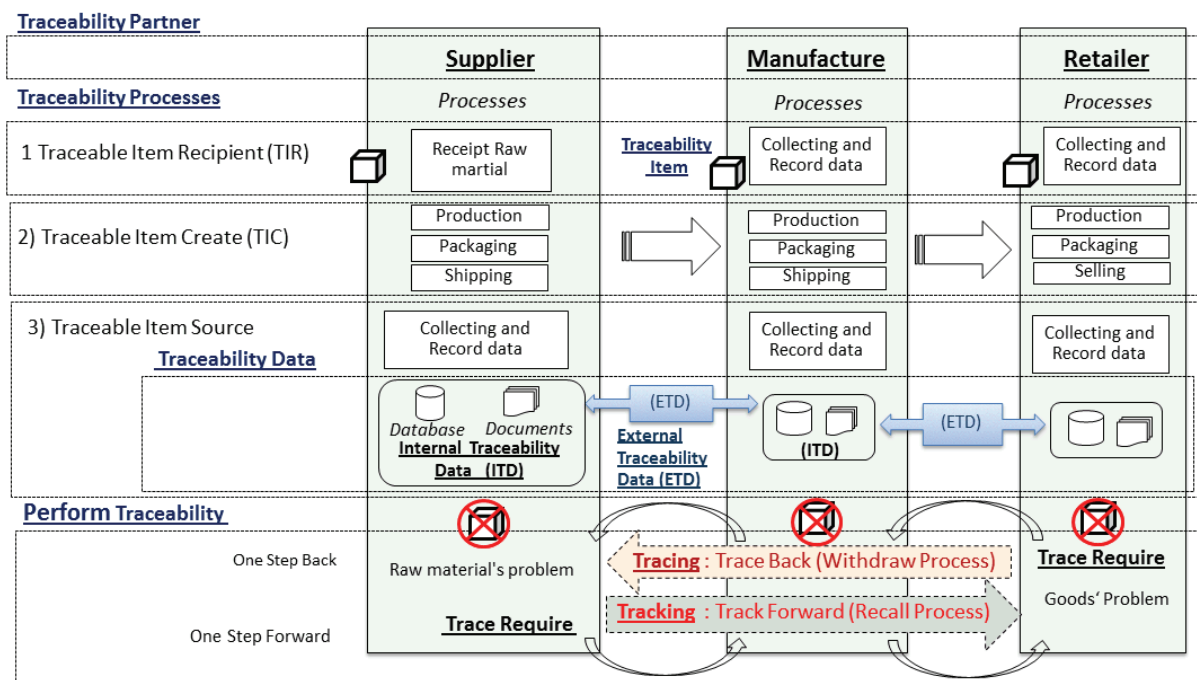
2.2.3 Traceability Perform/Traceability Require

When incident occurs external traceability data from label or container is using as the key criteria to link back to supplier to investigate the problem (tracing) and on the other hand it also sent to customer in order to recall the lot of problem product from the retailer's shell (Tracing). Before consumer reach the incident.

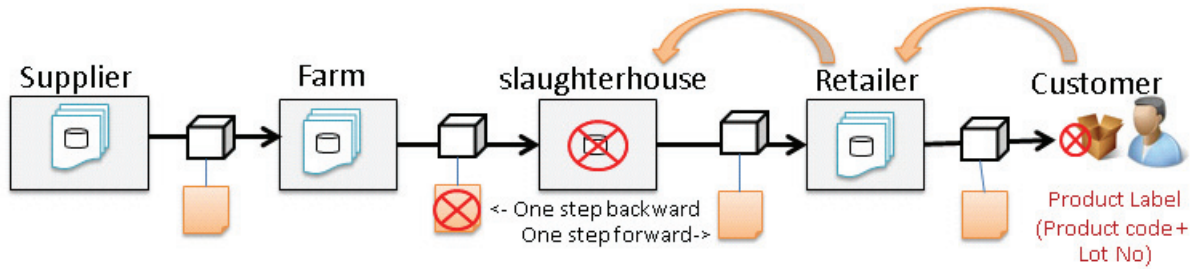### 2.2.4 Advantages of Traditional Traceability system concept

The advantage is flexible and easy to follow. Small and medium business can design and manage traceability system by them as well. Actually, It is acceptable to operate traceability system by manual paper base and reach a regulation requirements.

2.2.5 Disadvantages of Traditional Traceability system concept

The disadvantage is that the speed and efficiency of traceability perform is low. Because of many factors as below:

- Waiting time between traceability partners. It needs to waiting each anther partner respond one by one in order.
- Linking Fragile. If any linking data is lost or failed, traceability perform will be unacceptable as shown in figure 3. This could happen in two cases: losing label or partner ignore recording traceability data during its processes.
- Uncommon standard. This bring delay time in communicate 's process.

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Figure 4: Traceability perform will fail, if any linking data is losing

2.3 GS1 Global Traceability Standard (GTS)

The GS1 traceability standard was developed to provide a traceability framework for all industry sectors, for example, pharmaceutical, automotive, hardware as well as food. It Most of research paper recommend GS1 standard to solve uncommon standard and improve more efficiency of traceability perform. The GS1 standard province global standard and technical to manage a unique product Identify and communication between business to business. There are many case studies and best practice are used GS1 standard

2.4.1 The key success of GS1 is unique identification
Any product that needs to be traced or tracked, must be uniquely identified. The EAN•UCC globally unique identifiers are the keys that enable access to all available data about the product's history, application or location.
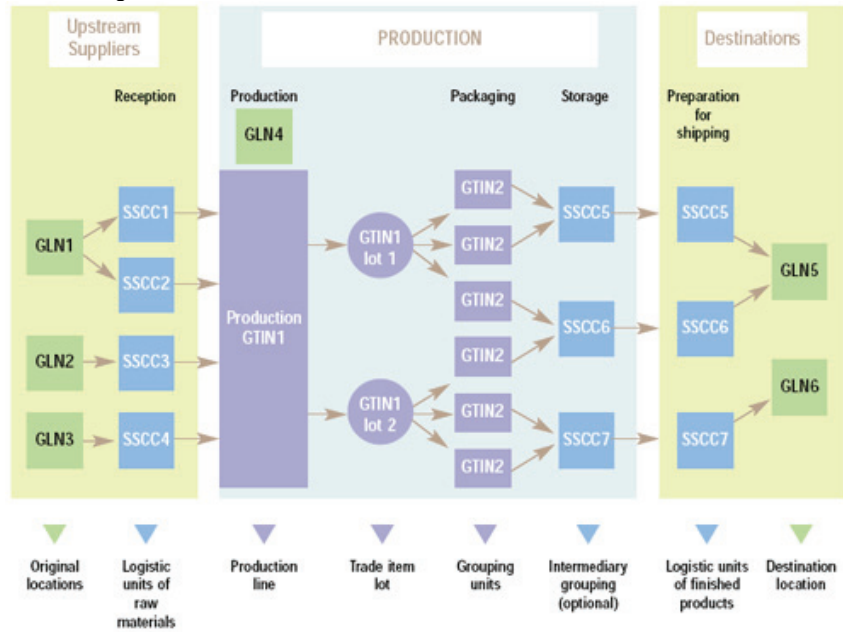
- Identification of Locations, unique identification of locations is ensured through the allocation of a GS1 Global Location Number (GLN) to each location and functional entity.
- Identification of Trade Items, unique product identifications ensured through the allocation of a GS1 Global Trade Item Number (GTIN) to each product (consumer unit). For traceability purposes, the GTIN has to be combined with a Serial Number or Batch Number in order to identify the particular item.
- Identification of Series, traceability of series is ensured through the allocation of a GS1 Global Trade Item Number (GTIN) and Serial Number to each product (consumer unit).
- Identification of Lots/Batches, traceability of Lots/Batches is ensured through the allocation of a GS1 Global Trade Item Number (GTIN) and Lot/Batch Number to each product.
- Identification of Logistic Units (pallets), identification and traceability of pallets is ensured through the allocation of an GS1 Serial Shipping Container Code (SSCC). Any pallet, independently of its type (mixed or uniform), needs to carry an SSCC allocated at source. A new SSCC must be allocated every time a new pallet (logistic unit) is created.

2.4.2 GS1 Links management
In the majority of supply chains, products are tracked and traced by their production batch, which has undergone the same transformation (production process) and by their transport/storage path (distribution process). The figure below shows the use of GS1 standards for identifying locations (GLN), logistic units (SSCC), manufacturing batches (AI 10) and consumer units (GTIN) in a production environment.

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Picture 5: GS1 Links management

Identification management in a production environment is characterized by:

- Several supplier locations (GLN 1-3), which send pallets of materials (SSCC 1-4).
- At reception, materials are stored and/or ordered for the production process.
- At the production site (GLN 4), consumer units (GTIN 1) are produced in separate batches (each identified with a distinct Batch Number).
- In the packaging step, consumer units (GTIN 1 and its Batch Number) are packed into standard grouping units (GTIN 2).

2.4.3 Advantages of GS1 Global Traceability Standard
The advantage is that all traceability partners have common standard. It can easy to communicate and share and transfer data throughout supply chain. The traceability perform is efficiency and accurate.

2.4.4 Disadvantage of GS1 Global Traceability Standard
The disadvantage is that all traceability partners must rely on the same standard. However applying GS1 standard ,it need a high investment in hardware and software such as Barcode system , RFID system and EPR system. Therefore small business cannot afford such high cost.

GS1 standard is concerning about produce code. One cow is spliced into 22 products and each product have 3 size of package. Therefore, 66 records of traceability data from one lot recorded are recorded as shown in figure

Figure 6: The 66 of GTINs are generated form a cow
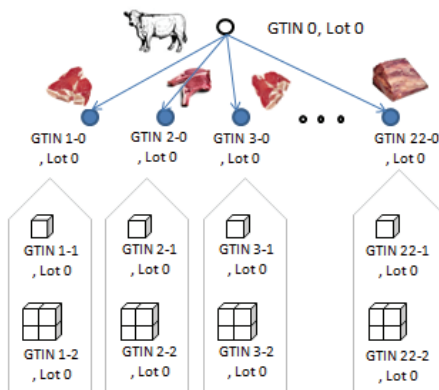
No	Product ID	Lot (Cow ID)	Raw ID	Create Date
1	GTIN 1-0	Lot 0	GTIN 0	1/6/2012
2	GTIN 1-1	Lot 0	GTIN 0	1/6/2012
3	GTIN 1-2	Lot 0	GTIN 0	1/6/2012
....	....	....	....	
64	GTIN 22-0	Lot 0	GTIN 0	1/6/2012
65	GTIN 22-1	Lot 0	GTIN 0	1/6/2012
66	GTIN 22-2	Lot 0	GTIN 0	1/6/2012

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## 3. THE WEAKNESS OF CURRENT TRACEABILITY SYSTEM

The main concerned by the definition to achieve in developing total traceability system are generally as follow:

- Complete of linking connection of external and internal traceability data. If any linking fail, all overall will collapse. The relation of Linking is concerned in three group:

  - Relation between lot/batch of raw material and supplier in receiving process.
  - Relation between lot/batch of raw material and lot/batch of product in manufacturing process.
  - Relation between lot/batch of product and customer in product delivery process

- Common standard and technology. In theory, all of acts in supply chain could rely on the common standard in order to achieve a rapid and accurate of communicated and transferred data processes. But in practical this issue is hard to occur. In case of applying GS1 standard, Small and medium business cannot invest such high cost and lock of knowledge and staffs.

- Sales model for fresh food products are often sold by the weight at the point of sale. Packaging and labeling are generated at retailer. If the retailer does care to transfer traceability to new label. The traceability linking data will be broken.

- Speed of traceability respond is low and unreliable. This concern is happening, if traceability partners have uncommon standard and low technology. Waiting time and delay time relate the number of acts involve in supply chain.

4. PROPOSE TOTAL TRACEABILITY SYSTEM

According to summarize of barrier section, A traceability No (Trace No or Trace Key) was introduced. This number is single unique number throughout supply chain that represent traceability unit. This concept is similar GTIN. GTIN's concept is a unique product code .but Trace No concerned about product traceability data. This number is represented by pentagon in figure 6. In order to managing Trace No is a unique throughout supply chain. It is necessary to establish a traceability database center for controlling and recording this number. Trace No is created in traceability item receipt (TIR) , traceability item create (TIR) and product transportation. Traceability partner who create Trace No can input more complex detail such as PDF documents and pictures that relate to Trace No. In addition the owner can set access and sharing authority to business partner and customers.
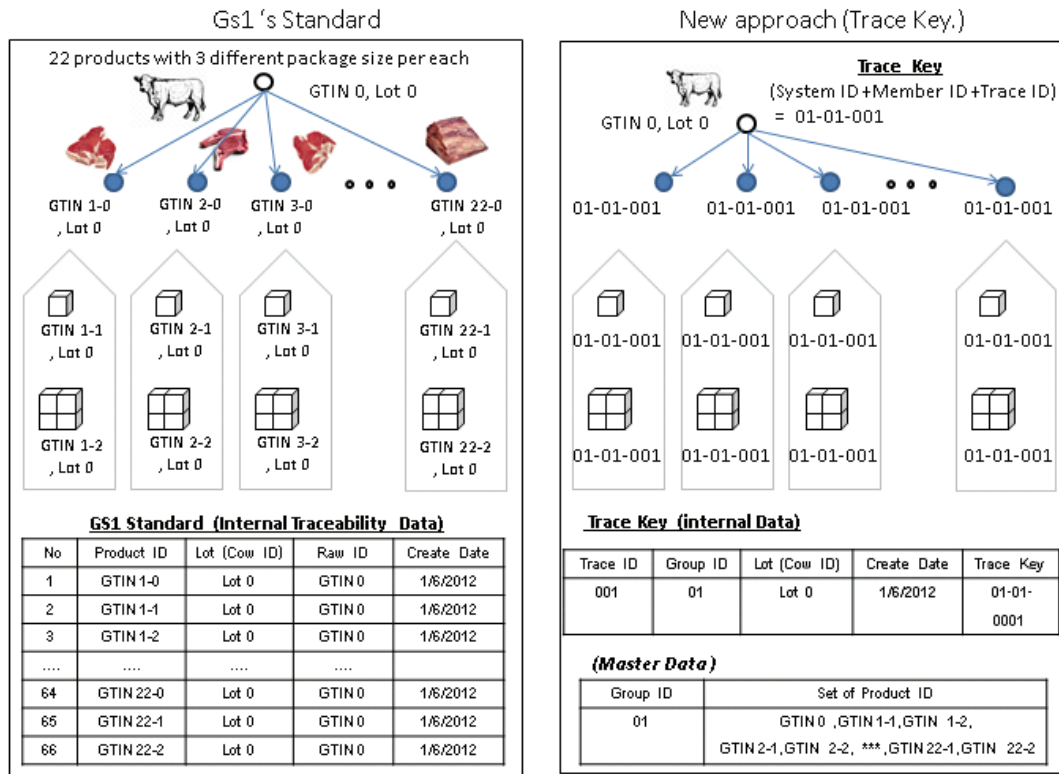
Picture 6: Show a Trace No 's concept linking traceability data in supply chain
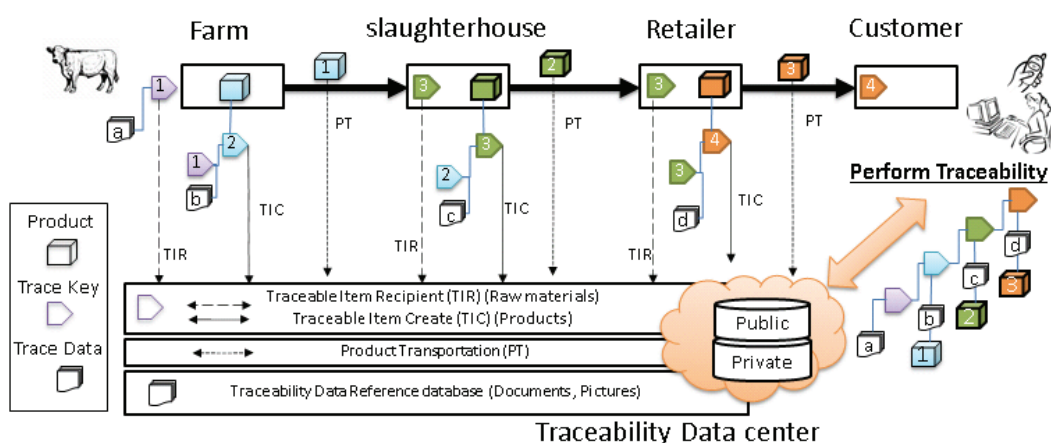
This concept allows partners who have different product standard can work together without change their existing standard and processes. The private product codes are recorded in traceability data center by owner.

In Picture 7, it points out the comparison of traceability data records between GS1 standard and Trace No approach. The approach way is reduced 66 times of time and data recording.

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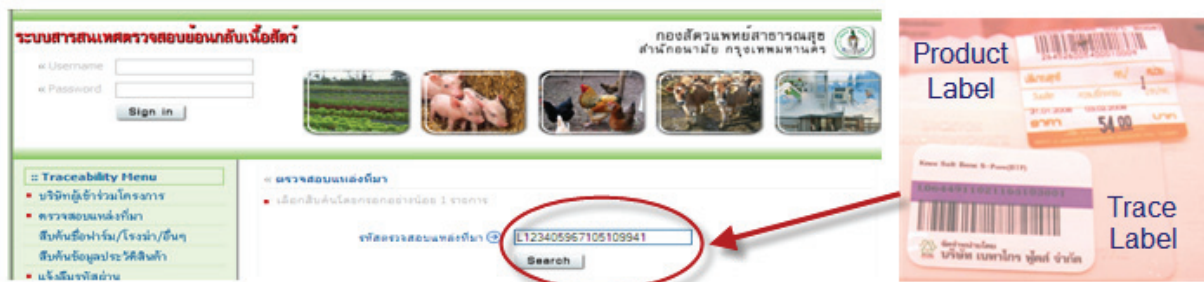**Picture 7:** Comparison between a Trace No 's concept and GS1 standard

5. CASE STUDY

Approach total traceability system was implemented in this research and two beef company have involved the system. The system provides only product traceability data. Logistic data will extend in further research. Both company input data into the system 2 time a week via internet connection. Both have the same product and organization as cooperative. Each company has more than four thousand members and produces 100 castles a week. There are two types of products that direct sale in their shop and indirect sale to supermarket and industries. All products are capable to trace back to the origin as shown the result in figure 8. The result of searching Trace No is consisted of

- Product detail (Lot no , manufacture date , expired date)
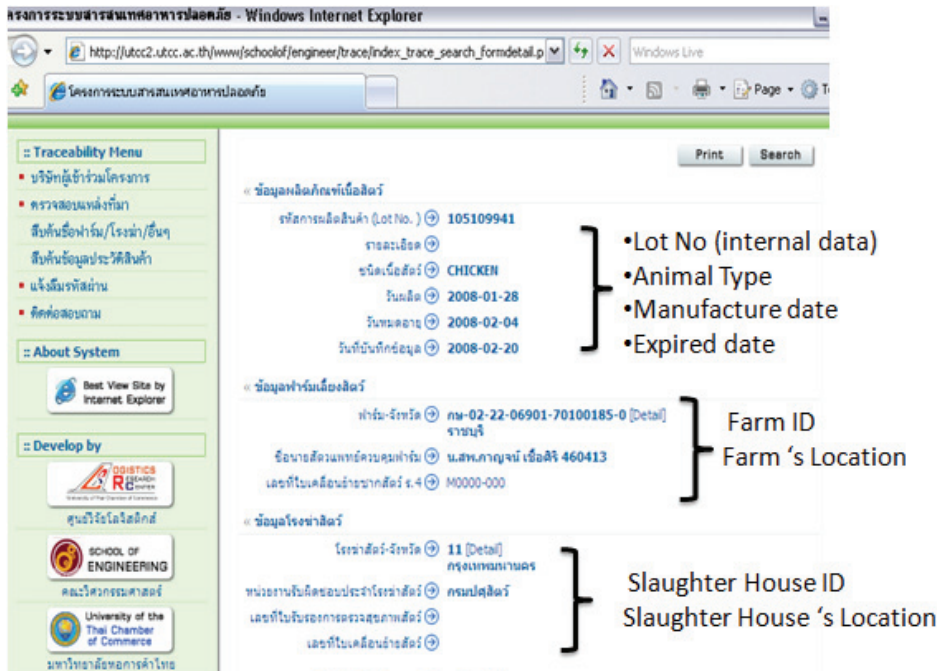- Farm ID and Location
- Slaughter house ID and location

In practical, a traceability label that contains Trace No and World Wide Web of total traceability system is separated form product label as shown in figure 7.By doing this way consumer will reach traceability label and access the data as well. In addition, both companies did not change their existing process anymore. They only increased a input process and put more traceability label on product package. In case of OEM there are only traceability label on package and product label will put on at the customer.

Figure 8: Searching Page of approach total traceability system

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Picture 9: The Searching result of approach total traceability system

6. CONCLUSIONS AND RECOMMENDATIONS

As the concerned criteria above, the Trace No was introduced to achieve research object to design appropriated total traceability system that is flexible, rapid and accurate to quickly response the food crisis. The result form case study was generated by two Thai beef businesses with individual traceability system but different standard system. It can performed traceability require as well as regulation requirements and GS1 standard. In addition both businesses can involve the system with unchanging their existing standard and processes. This approach is alternative way to create total traceability system to join individual business traceability system with different data standards. And it also is suitable for small businesses to establish their traceability system quickly and cheaply. Therefore, they can have the traceability ability as giant firms.

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