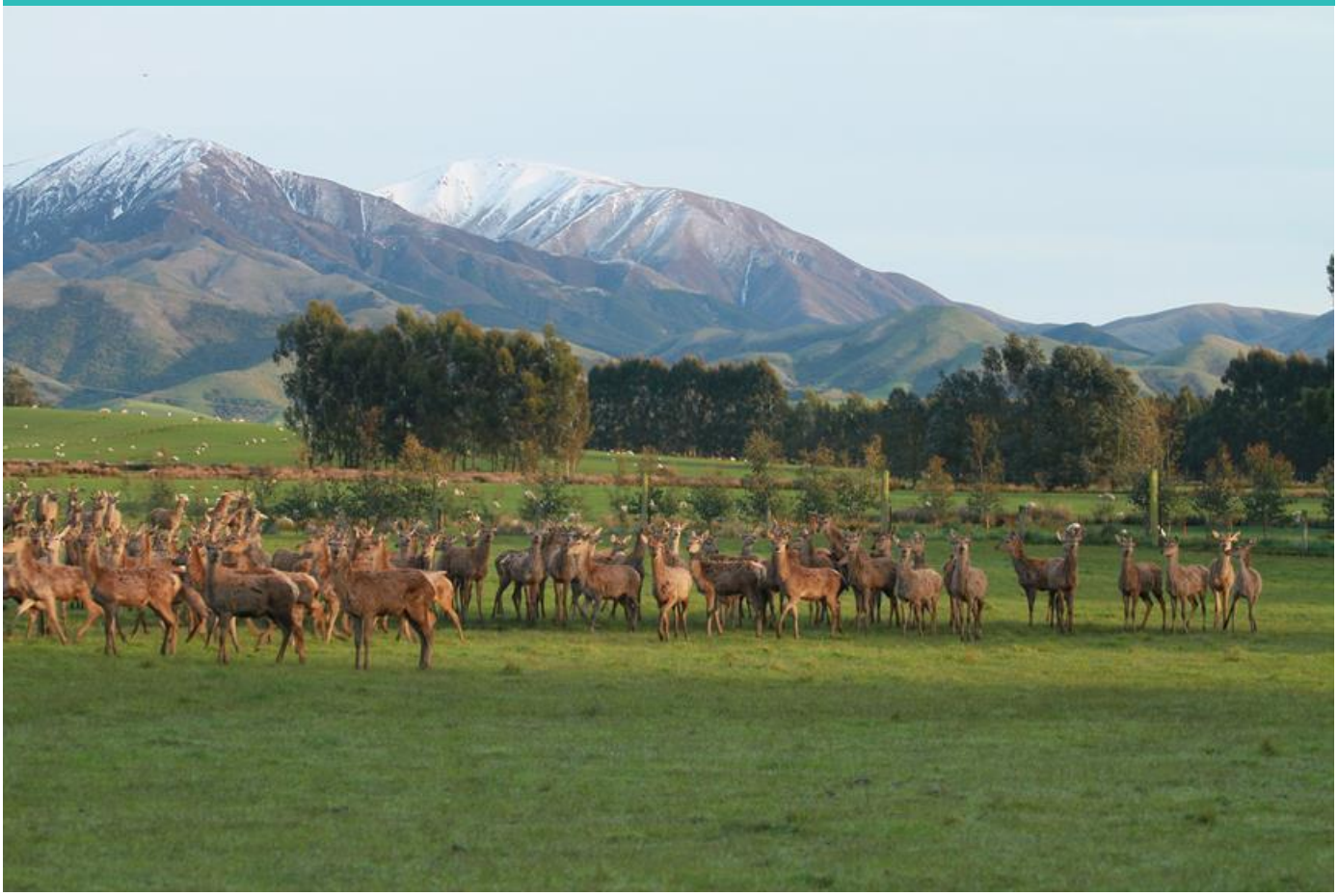
The Use of GS1 Global Data and Network Standards in the Deer Velvet Supply Chain to Demonstrate Product Traceability, Authenticity and Supply Chain Efficiency

A New Zealand Pilot



Deer Industry New Zealand

PROVELCO™ The Producers' Velvet Company

Supported by

GS1 New Zealand

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Executive Summary

Key Words

Traceability
Deer Velvet
Product Authenticity
Global Data Standards
Supply Chain Visibility
Radio Frequency Identification (RFID)
Electronic Product Code Information Services (EPCIS)

Governments around the world are drafting new laws and regulations requiring various degrees of traceability, especially in the food and food products industries. The new requirements are creating more demand for traceability than ever before. Different data standards are being used in trading relationships by governments, some industries and businesses. This results in duplication of effort, inefficiency and additional costs to government and business alike.

New Zealand deer velvet is a highly valued, low volume product that is difficult to differentiate in the market. As efforts continue to differentiate New Zealand velvet from its competitors as a premium food ingredient with a premium price, so does the incidence of counterfeit. Deer velvet is an animal product and companies involved in food and food processing are becoming increasingly concerned about product safety, authenticity and integrity.

RFID technology is seen to provide an efficient and often cost-effective solution to counterfeiting and falsification problems by enabling the unique identification of each container, pallet, case and item manufactured.

The pilot outlines the tracking and tracing of two velvet 'sticks'; one stick from two animals farmed from two discrete New Zealand locations. Using a fifteen (15) node supply chain design model, the pilot outlines the movement of each stick from farm through a processing phase, internal transport and logistics phases, exporting of product and finally, delivery of the sticks in two cartons (one stick in each carton) to a customer based in Seoul, South Korea. The pilot investigates and reports on the use of both manual data collection methods and RFID technologies used in unison with GS1 global data and network standards to determine the objectives as prescribed. GS1 identification standards were used where possible, to access and report efficacy in accordance with stated objectives.

The process of capturing and recording supply chain event information using both manual methods and RFID technology, provided comprehensive visibility into the *what, why, where and when* of an item as it moved through the supply chain. This visibility provided an efficient, accurate and robust solution for traceability, provenance and product authentication outcomes unlikely achieved using proprietary data standards and infrastructure.

Analysis of the event data illustrates time and date dimensions between critical tracking events that prove useful for post pilot analysis. Of particular note is the time from arrival of product in Incheon Airport, Seoul and delivery to customer (14 days); a surprise to the pilot stakeholders.

The pilot also serves to highlight the significant potential on offer for both process and supply chain optimisation to all stakeholders if they aligned on the use and implementation of a single suite of global data and network standards.

Background

Governments around the world are drafting new laws and regulations requiring various degrees of traceability, especially in the food and food products industries. The new requirements are creating more demand for traceability than ever before. Companies and regulators need systems than can provide robust end-to-end traceability with accurate information and precise identification of the products and services, locations and entities involved.

There is an ever increasing risk that physical products are not what they claim they are. Product authentication is needed to detect counterfeit and falsified products and to prevent them from entering the distribution channel of genuine products. One of the key issues concerning safety in today's global marketplace is the increasing risk regarding the production of fake branded goods.

Traceability systems serve several functions including authentication of provenance, public safety and mitigating economic loss. For consumers, the driving forces are increased sensitivity to food quality, safety and health and their interests in the place of origin of food produced.

Different data standards are being used in trading relationships by governments, some industries and businesses. This results in duplication of effort, inefficiency and additional costs to government and business alike. The practice increases the possibility of errors and inaccuracies and contributes to supply chain inefficiency and choke points. Governments and businesses alike should periodically review the data standards that are in use to ensure they are fit for purpose and represent the most efficient means of communication.

There is increasing international recognition of the contribution that global data standards can make to enhancing supply chain efficiency. APEC[1] highlights the broad benefits in the wider use of interoperable global data standards as:

- Efficiency: global data standards can improve the efficiency of supply chains by eliminating unnecessary transactions, and enabling better informed and more accurate risk assessments.
- Integrity: global data standards can be used to verify the integrity of a product throughout the supply chain.
- Visibility: global data standards can increase the visibility and transparency of supply chain processes.
- Innovation: global data standards can provide a platform for innovation by enabling new ways to utilise information through 'smart' supply chain processes.

RFID technology is seen to provide an efficient and often cost-effective solution to counterfeiting and falsification problems by enabling the unique identification of each container, pallet, case and item manufactured, shipped and sold. When used in conjunction with global data standards and specifically the Global Trade Item Number (GTIN), the Global Location Number (GLN) and the suite of Electronic Product Code (EPC) network standards (specifically the Electronic Product Code Information Service - EPCIS). RFID is seen as an effective tool for traceability and product authentication within the food and food products sectors.

New Zealand deer velvet is a highly valued, low volume product that is difficult to differentiate in the market. Historically, deer velvet was traded through opaque channels but in recent years there has been an increase in China's involvement as a processer and re-exporter of velvet mainly to customers in South Korea. As efforts continue to differentiate New Zealand velvet from its competitors as a premium food ingredient with a premium price, so does the incidence of counterfeit.

Deer velvet is an animal product and companies involved in food and food processing are becoming increasingly concerned about product safety, authenticity and integrity. To provide for this, Deer Industry New Zealand (DINZ) has invested in programmes to provide more certainty around country of origin (through in-market programmes) and audit tools (through specific isotopic signature proof of concepts).

[1] Annex A - APEC Statement on Promoting the Use of Interoperable Global Data Standards.
Refer: http://www.apec.org/Meeting-Papers/Ministerial-Statements/Annual/2014/2014_amm/annexa.aspx

Traceability and product authentication

There is an ever increasing risk that physical products are not what they claim they are. Product authentication is needed to detect counterfeit and falsified products and to prevent them from entering the distribution channel of genuine products.

There are many definitions and terms for traceability but, in practice, it is the ability to trace the history, application or location of an item (e.g. deer velvet) that is under consideration in a supply chain. The pillars of a traceability system are founded upon the unique identification of individual items, the ability to track the movements of them through the supply chain, unique identification of premises and recording of this information in appropriate registers. There must be a means of linking the identification and traceability of items and the traceability of items to achieve traceability throughout the item's 'life cycle'.

Key Data Elements

Every critical tracking event contains **Key Data Elements** (KDEs) that provide the information business applications needed to understand what has occurred in the supply chain. Each Critical Tracking Event (CTE), records the completion of a single step of a business process, and so the key data elements provide the information necessary to describe it. The key data elements of CTEs are organised into four dimensions of data: *what*, *when*, *where*, and *why*.

- **What**: data elements that identify the traceable objects that were involved in the event.
- **When**: data elements that indicate the date and time at which the event took place.
- **Where**: data elements that describe the location of the event, including the location where the event took place and where traceable objects are expected to be following the event (until another event says otherwise).
- **Why**: data elements at provide the business context. This includes identifying what business process step was taking place, the state of the traceable items, links business transaction documents such as the purchase orders, invoices, etc., and identifying parties to a transfer of ownership or custody (in the case of transfer-type events).

Within this general framework of *what*, *when*, *where*, and *why*, specific choices of data elements and the values that populate those data elements can be made for each step in an overall business process that is to be traced.

End-to-end integration: GS1 Standards go where the product goes

The Global Trade Item Number (GTIN) is an identification number that unambiguously identifies products and is the most efficient and effective identifier to communicate product information in supply chains and beyond. The Global Location Number (GLN) is used as a consistent standard to identifiy legal entities and physical locations.

GTIN and GLN are GS1 global standards and remove the need for proprietry identifiers[2]. The Serial Shipping Container Code (SSCC) is a unique GS1 identifier for use with logistic units (e.g. cartons, pallets). The SSCC is a crucial key for traceability since it uniquely identifies each distributed logistic unit and its contents.

GS1 has developed network and information exchange standards for the visibility of products moving through the supply chain – called the EPCIS (Electronic Product Code Information Systems). EPCIS is now widely recognised as the de-facto method to share track and trace information and is widely used internationally[3].

[2] To achieve what is referred to as *'instance level'* identification, a serial number can be encoded into a GTIN and a GLN to create a serialised GTIN (sGTIN) and a serialised GLN (sGLN).

[3] The EPC Architectural Framework is a secure means to connect servers containing information related to items identified by using globally unique numbers known as Electronic Product Code (EPC) numbers. The servers, called EPC Information Services (EPCIS) are linked via a set of standards-based network services and the internet. EPC

The pilot

Purpose

New Zealand's annual deer co-product exports are NZ$65m[4] where 75% is destined for the APEC region. These products are well respected in the traditional oriental health market particularly in Northern Asia. As these markets become wealthier, demand for these products increases. With a clean green image, coupled with a global respect for its food safety practices, New Zealand is well placed to take advantage of growing consumption for such products. Demand for New Zealand deer co-products is increasing relative to its competitors. In addition, the markets are beginning to change from traditional medicine markets and practices to ones requiring more levels of sophistication where safe, high quality ingredients and processing processes are required.

Deer Industry New Zealand is keen to investigate new technologies that can enhance the integrity of its products in global markets. This pilot was able to test and examine technologies that could provide the customer with assured product authenticity. Furthermore, it could assist with identifying potential choke points and expedite product delivery to market - from pasture to plate.

There is broad interest within the APEC economies in the use of global data standards to join up G2G/G2B and B2B. Alignment around a suite of global data standards (GDS) like those of GS1 between governments, their agencies and business could streamline supply chain efficiency and reduce unnecessary choke points and inefficiencies. Traders would only be required to submit each piece of information only once to cross-border regulatory agencies thereby reducing compliance and transaction costs to business. Optimally, data should be submitted at the earliest point in time in the supply chain where the advanced information would improve agencies' ability to manage risks, reduce the risk of goods being stopped and inspected unnecessarily (thus reducing costs for government and business) and facilitate legitimate trade more efficiently.

Outline

The pilot outlines the tracking and tracing of two velvet 'sticks'; one stick from two animals farmed from two discrete New Zealand locations. Using a fifteen (15) node supply chain design model, the pilot outlines the movement of each stick from farm through a processesing phase, internal transport and logistics phases, exporting of product and finally, delivery of the sticks in two cartons (one stick in each carton) to a customer based in Seoul, South Korea.

The pilot investigates and reports on the use of both manual data collection methods and RFID technologies used in unison with GS1 global data and network standards to determine the objectives as prescribed. GS1 identification standards were used where possible, to access and report efficacy in accordance with stated objectives[5].

Where data was captured using manual methods for specific critical tracking events, the event information was sourced from manual records. Event data using RFID technology (i.e. RFID readers) was *captured* in 'real time'. In both cases, *recording* of event data into the EPCIS repository was not completed in real time as the hardware and network infrastructure required to enable this was deemed out of scope for this pilot[6].

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standards and The EPC Architectural Framework are being used around the world to provide supply chain visibility and traceability.

[4] As at 2015.

[5] An important caveat is necessary however. Currently, proprietary identifiers are invariably used throughout the industry to identifiy animals, individual deer velvet sticks, locations and logistics units (i.e. cartons) with no interoperability of data between stakeholders.

[6] This should not be considered as undermining the relevance or utility of the pilot, as while real time capture and recording is optimal in 'live supply chains', the pilot sought to demonstrate the use and efficacy of global data and network standards (including event dates and time), not the benefits and effectiveness of real time data capture and recording.

This end-to-end supply chain integration represents the first known instance globally, where a consortium of farmers, processors, industry associations and customers involved in the deer velvet industry, have collaborated in using these global data and network standards in the supply chain to demostrate robust traceability, provenance and product authentication outcomes.

Objectives

The pilot had three primary objectives:

1. To demonstrate the efficacy of using GS1 global supply chain standards for product traceability and authenticity outcomes.
2. To identifiy where GS1 global standards can be used more broadly and effectivly by a community of supply chain stakeholders to demonstrate enhanced supply chain optimisation opportunities.
3. To examine the functionality and performance of GS1 New Zealand's recently implemented EPCIS.

Shipment visibility information using the EPCIS

To retrieve the pilot tracking event data, the EPCIS repository is queried. Typically, it is the sGTIN or the sGLN that is used as the query identifer. A key component of the EPCIS event reporting function is the use of a *core business vocabulary (CBV).* The vocabulary identifiers and definitions ensure that all parties who exchange EPCIS event data have a common understanding of the meaning of that data. A summary of the CBV used in this plot is:

- *Business Step* - The specific activity within a business process i.e. an event that specifies what business process step was taking place that caused the event to be captured.
- *Disposition* - The business state or business condition of an object in the 'what' dimension subsequent to the event.
- *Read Point* - The location where the EPCIS event took place.
- *Business Location* - The location where the subject of the event is assumed to be, following an EPCIS event until a new event takes place that indicates otherwise.

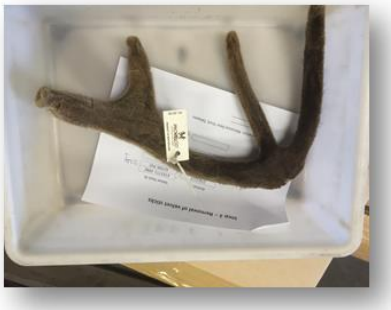
The EPCIS architecture provides for the virtual 'attachment' of documents such as an air waybill, a bill of lading, customs declaration, phytosanitory certificate for example. Benefits could include more convenient, faster access to documents and allow faster shipment alerts (pre-alerts) and pre-clearance options for regulatory and border agencies. Post shipment archiving and retrieval are also attractive benefits especially if supply chain partners have authorised access to the information.

Pilot supply chain tracking events

From the unique identification of an animal on farm, to delivery of cartons of deer velvet to the customer in Seoul, South Korea, the GS1 identification (GTIN, GLN, SSCC) and network (EPCIS) standards were used to identify the *what, why, where and when* details of the items as they moved through the fifteen (15) node supply chain.

1. From farm to processor (New Zealand)

In the pilot, each deer and the individual 'stick' removed from the animal was assigned a sGTIN. Each farm was assigned a sGLN as was the *location* where an *event* occured. This provided a unique identification of each animal and stick and established an association between the two as well as the farm it came from. The event information was recorded (manually) both on the farm and on arrival into the processors facility. Information was populated into the EPCIS repository.



2. Processing (New Zealand)

Various internal processing steps were undertaken and the information captured was recorded in the EPCIS repository.

In preparation for export, each of the two (2) deer velvet sticks were packed into separate cartons. The sGTIN of each stick was recorded manually as was the physical location of the event identifying *where* the process (packing) occurred. The location identifier used was sGLN.

Each of the two cartons (logistics units) was assigned a unique SSCC identifier which was encoded into a RFID tag then affixed to each carton (as highlighted). During the packing process, the sGTIN of the velvet stick was recorded (manually) and an association made with the carton SSCC. A 'fictitous' shipping document was loaded into the system. All event information (sGTIN, SSCC, sGLN) was populated in the EPCIS repository.

3. Export transport and shipping (New Zealand)

As each of the two cartons left the processor's facility for export shipping, the SSCC's of each carton and the sGLN of the *event location* were captured and recorded using a combination of manual and RFID scanning methods.

On arrival into the local logistics provider's facility, the sGLN of the *event location* was recorded as was the SSCCs of each carton, thereby establishing a relationship between them. This process was replicated as the cartons were receipted into the export carrier's (the airline) staging facility located in a different city.

4. Customs and FDA Clearance (S.Korea)

After The Korean Customs Service and The Korea Food and Drug Administration (KFDA) completed their respective inspections and clearace procedures at Incheon International Airport (Seoul), the cartons were made available for collection. The carton RFID tags were read using hand held RFID readers and the data recorded in the EPCIS.

5. Delivery of cartons (S.Korea)

The cartons were receipted into the customers warehouse where the identifiers encoded on the RFID tags from each carton were captured using RFID hand held readers and the data recorded in the EPCIS.

Event information recorded and reported using the EPCIS

Outlined below is a selection of critical tracking events illustrated as screenshots, captured from the EPCIS repository. Explainations are provided on the *what, why, when* and *where* dimensions of the events.

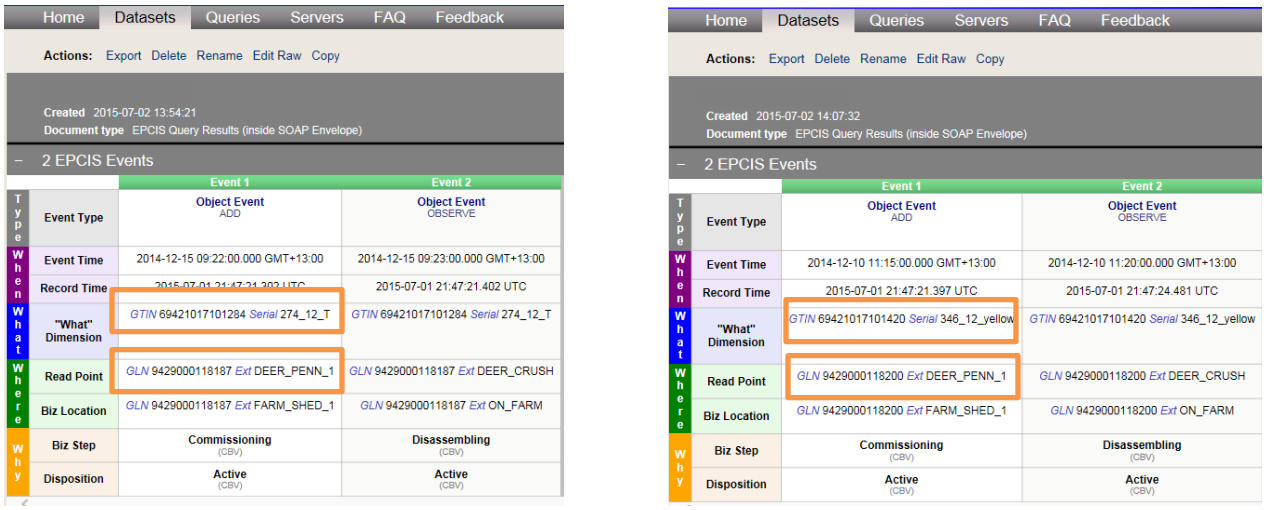


Figure 1 – Capturing the animal identification of farm

Figure 1 illustrates the recording of the identification number for two animals (*what*) undertaken on two discrete farm locations. The globally unique identification number used for each animal is a combination of:

Global Trade Item Number (GTIN) *69421017101284 + farm assigned number 274_12_T*
Global Trade Item Number (GTIN) *69421017101420 + farm assigned number 346_12_yellow*

The combination of GTIN + (farm assigned) serial number, creates a *Serialised Global Trade Item Number* (sGTIN) and establishes an *instance level* globally unique identification number for an animal namely:

Animal 1 – 69421017101284.274_12_T
Animal 2 – 69421017101420.346_12_yellow

The two farms (*where*) were assigned a GS1 Global Location Number where:

GLN 9429000118187 is the *globally unique legal entity identifier* for Farm 1 and,
GLN 9429000118200 is the *globally unique legal entity identifier* for Farm 2.

Descriptions such as DEER_PENN_1 and DEER_CRUSH were used to define a *specific location* on a farm where a tracking event took place, in this instance, the velvet was removed in DEER_PENN_1 in the DEER_CRUSH.

Also illustrated is the time and date when the tracking event was captured and recorded.

A globally standardised *core business vocabulary* (cbv) expressing *why* an event was occurring was used, (e.g. where *Commissioning* refers to associating an identifier with initiating a new process; for example, assigning a unique identification number to a deer for the first time).

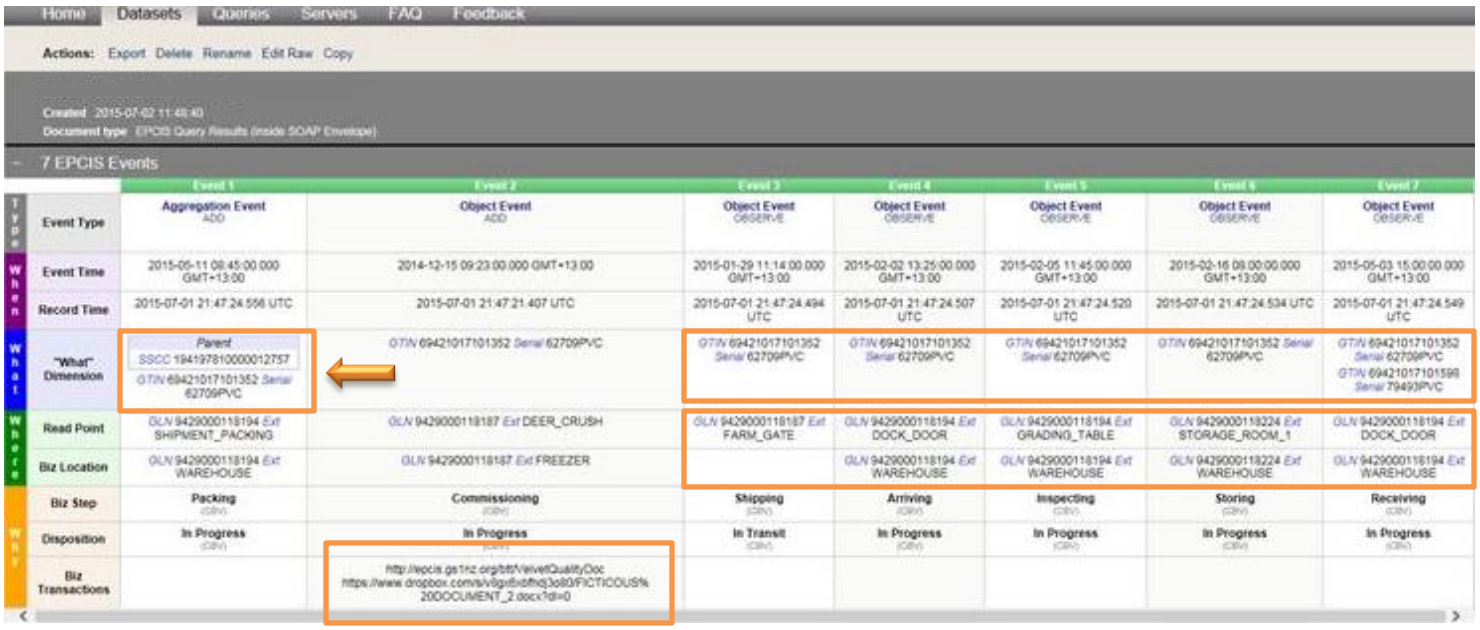


Figure 2 – Capturing event data for the removal of the velvet from the animal on farm

Figure 2 illustrates seven (7) critical tracking events relating to one (1) of the two (2) velvet sticks involved in the pilot. The unique identification of the velvet stick is a combination of:

Global Trade Item Number (GTIN) *69421017101352* + (processor assigned ID Number) 62709PVC.

The combination of GTIN + (processor assigned) serial number, creates a *Serialised Global Trade Item Number* (sGTIN) that provides an *instance level*, globally unique identification number for the velvet stick namely:

*Velvet Stick 1 - 69421017101352.*62709PVC.

Events 3-7 inclusive, illustrate a series of discrete critical tracking events (*where*) relevant to one (1) velvet stick (*what*) as outlined. The tracking events outline details of transits between different physical locations (e.g. farm and processor, processor and export facility), where the velvet stick is described as stored, graded or inspected. Locations are identified by unique *Global Location Numbers (GLN).*The *business steps* (*why*) are all identified, as are times and dates.

Of particular note is critical tracking *Event 1*. This event highlights the velvet stick (sGTIN - 69421017101352.62709PVC) being packed into a carton (cbv bizstep description: *packing*) for export purposes. The unique carton identifier used is a *Serial Shipping Container Code* (SSCC) – 194197810000012757, a GS1 globally unique identifier used for identifying individual and unique logistics units (e.g. cartons, pallets etc.).

Event 2 highlights an example where a document is able to be associated with a critical tracking event and be stored in an on-line repository (represented by a URL) for downloading by authorised supply chain stakeholders (traders, border agencies etc.) at any time. This functionality should provide opportunities for expediting and enhancing shipment operations (e.g. border clearance procedures) among other benefits.

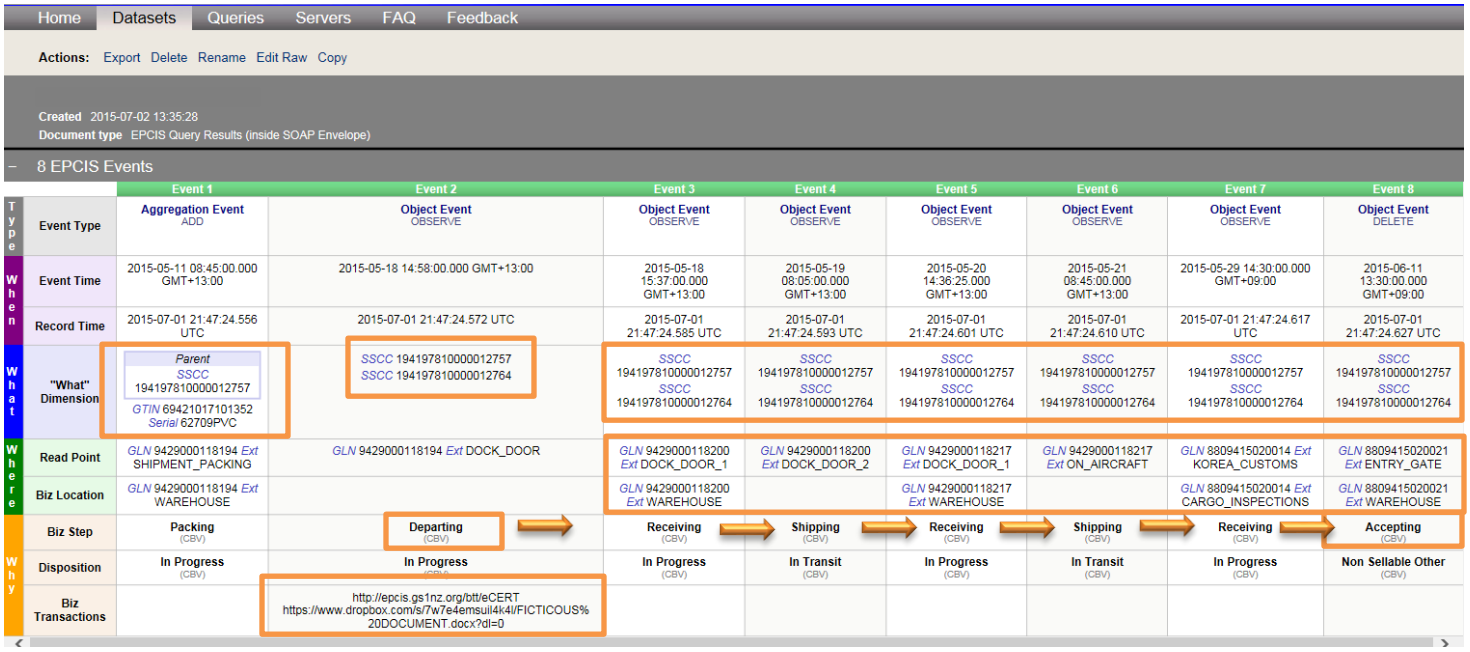


Figure 3 – Capturing critical tracking events for export cartons

Figure 3 illustrates eight (8) critical tracking events related to the transit of the two (2) pilot export cartons, each containing one (1) velvet stick. Each carton is identified using a *Serial Shipping Container Code* (SSCC).

Event 1 outlines the relationship between an individual velvet stick (sGTIN 69421017101352.62709PVC) and the carton it is packed in for export (SSCC 194197810000012757).

Events 2-8 inclusive, outline a series of shipping, receiving and accepting tracking events from point of despatch in New Zealand (i.e. Event 2) to receipt of the cartons at the consignees warehouse (*accepting*) in Seoul, South Korea (i.e. Event 8). The discrete *physical locations* are identified by the Global Location Numbers as follows:

New Zealand Processor - 9429000118200.DOCK_DOOR_1
South Korean Consignee - 8809415020021.ENTRY_GATE

Event 2 also highlights another example where a document is able to be associated with a critical tracking event and stored in an on-line repository (represented by a URL) for downloading by authorised supply chain stakeholders at any time. Event times and dates are recorded.

Conclusion

The pilot outlines a process of identifying items, legal entities and physical locations using an integrated and interoperable combination of global data and network standards. The process of capturing and recording supply chain event information using both manual methods and RFID technology, provided comprehensive visibility into the *what, why, where and when* of an item as it moved through the supply chain. This visibility provides an efficient, accurate and robust solution for traceability, provenance and product authentication outcomes unlikely achieved using proprietary data standards and infrastructure.

Despite the event data not being recorded in the EPCIS in *real time*, analysis of the event data illustrates time and date dimensions between critical tracking events that prove useful for post pilot analysis relevant to Objective 2. Of particular note is the time from arrival of product in Incheon Airport, Seoul and delivery to customer (14 days).

The pilot also serves to highlight the significant potential on offer for both process and supply chain optimisation to all stakeholders if they aligned on the use and implementation of a single suite of global data and network standards. There seems little doubt that if a standards-based approach were adopted and implemented by supply chain partners where automatic data capture technologies such as RFID, barcodes and barcode scanning were used, quantifiable benefits could be realised. Automation in this manner would provide for a faster, more accurate less error prone process thereby providing an enhanced reporting capability for analytics and audit potential. Improved stakeholder interoperability also provides tangible benefits including faster more efficient product validation, product recall/ withdrawal for example.

The EPCIS infrastructure purposely built for this pilot performed to the high expectations set and should provide comfort for those considering commercial applications. Of particular utility to supply chain partners is the ability to access shipment related documents in the EPCIS repository. This is seen to provide numerous benefits to supply chain partners where benefits cwould include easier, faster access to documents in an on-line environment to enable potential for faster shipment alerts and clearance options for regulatory and border agencies. On-line, secure document archiving and retrieval has obvious benefits.

Recommendations

The researchers encourage continued research where:

- An industry/ government partnership funding model is established and agreed.
- A research framework based on the use of GS1 global data standards for the identification of items, legal entities, physical locations and EPC network and infrastructure standards is utilised.
- Automation of processes is utilised.
- Inclusion of a broader stakeholder community is involved including government and regulatory agencies (e.g. Ministry for Primary Industries, New Zealand Customs) as their involvement may uncover opportunities relevant to their remits.
- Involvement of offshore regulatory and border agencies.

About Deer Industry New Zealand

Deer Industry New Zealand is responsible for promoting and assisting the development of the New Zealand deer industry. Deer Industry New Zealand has a worldwide co-ordination role through research and promotion of quality products derived from deer - especially venison, velvet and co-products.

About GS1 New Zealand

GS1 New Zealand is New Zealand's member organisation of GS1, the global non-for-profit supply chain standards development organisation. With 112 offices around the world serving over two million members, GS1's supply chain standards are the most widely used suite of in the world today. GS1's mission is to empower organisations to grow efficiently, sustainably and safely - helping transform the way we work and live. GS1 standards enable organisations to identify, capture and share information smoothly; creating a common language that underpins systems and processes all over the world.

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