

Key elements of a traceability system

Before contemplating the technologies that can help with traceability and/or authenticity in your business, you need to make some decisions about what you are going to trace, what data you will collect as well as where and when you will collect it. It is also important to consider who needs to access the data..

There are four main elements of a traceability system (can we do this as an illustration?):

1. *Traceable entities*: This can include trade units (individual items), batches (lots), logistic units (pallets) or shipments. The important thing is that consistent, uniform definitions support interoperability through the supply chain to the customer/consumer.
2. *Unique identifiers*: Uniqueness is the key to distinguishing between the traceable entities
3. *Key data elements (KDEs)*: The data about the traceable entities that need to be collected and stored.
4. *Critical tracking events (CTEs)*: The points where KDEs need to be collected.

Unique Product Identifiers and Batches

The foundation block of traceability is the product, so your first decision is to define what you will trace and to assign each one a unique identifying number.

It may not be possible or practical to identify each product individually, so you will need to decide whether you will batch the products and apply a unique identifier to the batch. A batch usually applies to products that have similar attributes, such as harvest location and date. But don't worry, this does not need to be too complicated – it is your decision. It is what makes sense to you in your business.

You can start in one way, and then after trying it for a while, you may decide to change it. For this reason, you might like to use a simple traceability system (e.g. pen and paper or a spreadsheet system) as you work this out.

If you already have this sorted, don't forget to explain your unique identifier system to any technology supplier to ensure that it integrates nicely.

You can choose any identifier that makes sense to you; however, you may also like to consider using GLOBAL TRADE ITEM NUMBER (GTIN), the GS1 standard for identifying items traded in a supply chain. GTINs are 14-digit identifiers to ensure uniqueness.

Critical Tracking Events

The next decision is to decide at what point in the process will that identifier be applied (or recorded). For example:

(use icons for the following):

- At the point of harvest or receipt?
- When the product is transferred to the processing facility or packing shed?
- When it leaves the processing facility/packing shed?
- Based on customer requirements?
- If you add anything to the product (e.g. flavours, ingredients) or process (e.g. packaging) it somehow, will it be transformed into a new product?

Step 2: Traceability and authenticity technologies list

Your personalised traceability chooser report includes a suggested **technology starting point** calculated for you based on the answers you provided in the chooser quiz.

As every business is quite different, we have not provided you with a definitive answer regarding technology that will suit you and your business. Instead, what we have done is provide you with a guided decision process.

The following few pages include descriptions of several different traceability technologies that you might like to investigate and consider whether it is suitable for your business. You will see a colour coding associated with each technology type. These colours correlate to the colour listed in your personalised report. Of course, it is only a starting point suggestion, and you are welcome to investigate any or all the technology types included in this list.

We have briefly described each of the technology types and provided a curated set of resources to help you understand how they work, including:

1. Case studies – short descriptions of how other businesses have used traceability and authenticity technologies
2. Technology suppliers – these are not endorsed by us but are provided to illustrate the technology type
3. Additional information and reports - these are available in the resources library available here www.traceabilitychooser.com.au.

There are many systems and platforms to choose from and, as technology develops, the list may change.

Now over to you!

Green List

There is only one technology listed here because using it requires no digital skill.

If you can use a smartphone, you should probably look at some of the other technologies (particularly those on the orange and yellow lists). Many of these technologies have an advantage over pen and paper as they can save you time, mainly if you are in a recall situation OR answering queries from your customers.

Paper-based

A traceability system does not have to involve digital technologies. For example, paper records, such as purchase orders, invoices, and handwritten labels, can be used to capture, store, and share information about your products and can be used for traceability.

Paper-based traceability is still used widely and can involve a combination of printed and scanned documents sent via email.

From a practical point of view, paper-based systems can be very time consuming and challenging to scale. However, some basic digital skills can quickly improve the efficiency of this kind of traceability system. Moving to a simple spreadsheet or other technologies, such as scanning codes, is a logical next step.

If you need help building digital capabilities and skills, we have provided some resources in our Traceability Chooser Resource Library www.traceabilitychooser.com.au.

Orange List

The technologies on the Orange List require some basic digital skills. If you can use a smartphone, you can probably follow the steps to use these technologies. These are also relatively low costs. However, spreadsheets can get complicated – depending on what, when and how you are tracking your products. If it is too complex, don't give up! We recommend that you seek some help using the resources we have provided in the library OR from someone else. You can also look at some of the technologies on the other lists (particularly the yellow list). Many of these technologies include easy to use data collection and reporting formats.

Spreadsheets

You can set up spreadsheets to track product information, for example, unique product identifier numbers, product descriptions, harvest locations, quantity in stock, reorder points, value and more. You can also include expiration dates, customised notes, and pictures.

Many businesses use spreadsheets to track inflows and outflows of inventory; however, it doesn't automatically alert you to critical events, e.g. when stock has reached its reorder minimum or consider delivery lead times.

By itself, a spreadsheet system does not provide any customer-facing information about the product journey, product quality on receipt or authenticity.

For examples of spreadsheets and tips on using them for traceability, check out the Traceability Chooser Resources Library www.traceabilitychooser.com.au

Simple labels

Non-dynamic QR Codes

A QR code (short for quick response code) can be a great, simple way to tell your story and provide your customers with the assurance that they have a genuine product.

A QR code is a barcode containing a matrix of dots. It is scanned using a QR scanner or a smartphone with a built-in camera. QR codes have a high information storage capability, including text, URLs, and webpages.

Here are the steps to get one that suits you:

1. **Find a QR code generator.** There are many online, and many of them are free (some are free but have limited scanning while others do not have that limitation).
2. **Select the type of code you want.** The kind of code you choose will depend on what you want to do with it and how you want the consumer to engage. For example, you may want a website QR code, a video QR code or a coupon QR code. There are many other options.
3. **Add all the information you want to it.** You do this when you generate the QR code in the QR code generator app. So, for example, if you want the consumer to

go to your website when they scan the QR code, you'll need to add in your website URL.

Test your QR code. When you're happy with your QR code, you need to test it out to make sure it works properly.

Yellow List

The technologies on the Yellow List require a bit more than basic digital skills. If you can use a smartphone, download apps, do a google search on a computer, follow instructions on YouTube, you will most likely follow the steps to use these technologies. The cost of these technologies are reasonable and depend on the specific needs of your business.

Trackers

Trackers are placed in shipments to record data on the performance of supply chains from production to customer, from farm/boat to retail shelf. The data inform decisions about the management of products and guides investment in the supply chain by providing visibility of critical factors such as temperature and dwell time and enable corrective actions. Having access to this data can reduce rejections, product wastage and consistent quality product deliveries to customers.

Some trackers provide real-time information back to base while others need to be retrieved and the data downloaded before analysing. The advantage of real-time information tracking is that corrective actions can occur while the product is in transit.

Case studies:

Providers:

Smart labels

Smart labels include stickers, seals, engravings, and smart tags. It is an umbrella term for any labelling that uses technology to add functionality and data beyond a traditional simple barcode, for example, data embedded barcodes, RFID, and dynamic QR codes. The labels are attached to the product or the packaging and embedded in packaging in some cases.

In addition to supporting traceability, smart labels can also provide customers with information about the product, for example, freshness. Smart labels are evolving quickly with new technologies and technological improvements.

More recent developments include smart labels and packaging containing an IoT (Internet of Things) sensor that can detect changes in temperature and humidity while the product is in transit or storage. They can also indicate tampering, so they help support authenticity.

The most common Smart Labels include:

Radio Frequency Identification Data (RFID)

Uses small tags attached to products to store and transmit electronic product codes (EPC). Passive RFID tags require the use of stationary or handheld readers that electronically prompt the tags to share data. Unlike barcodes, RFID tags do not need to

be in the line of sight of a reader. Active RFID tags use their power supplies to send information to readers that can be up to a mile away. Implementation of RFID requires tags, labelling devices, readers, and information technology systems.

Case studies:

Providers:

Barcodes

A series of thin and thick lines that carry machine-readable information about a product: the barcoding standards for consumer products are EAN-8 (8-digits) and EAN-13 (13 digits). The standard used for logistical units is ITF 14 (14 digits). In addition, GS1-128 (up to 129 alphanumeric characters) is used within the GS1 Standard to allow barcodes to include specific product attributes such as harvest dates, harvest locations, lot numbers, quantities, weights, and packing dates. The hardware for barcode labelling includes labels, label printers, scanners, and computer systems.

Case studies:

Providers:

Dynamic QR Codes

We introduced static QR codes under simple labels. However, static QR codes have the disadvantage of not being able to be updated. To keep from being stuck with a QR code that you can't ever update, you have the option of creating a dynamic QR code. With this type of code, you can change the target URL or content at any time, including after you've already printed and distributed hundreds of copies of your marketing material.

The key is to make sure that you connect your QR code to the correct information that you want your customer to see. Imagine your customers' dismay when they take the time to scan your code just to find a broken link or outdated information - a mishap that can be avoided.

It is a good idea to add a call to action that makes consumers want to scan your QR codes. Even a simple 'Scan Me!' has proven to engage a lot more users than codes without a call to action. The more attractive the call to action, the more likely consumers are to scan your QR code. For example: 'scan this code to see our fishers and/or farmers in action!'

Case studies:

Providers:

Digital Fingerprints

A step up from the QR code is fingerprinting. QR codes were designed to identify, not authenticate. Laava Smart Fingerprint® technology removes the data from the code and turns it into a secure, scannable mark as unique as your fingerprint.

Customers scan the fingerprints using their smartphones to verify product authenticity and connect them with the provenance story. In addition, the fingerprint can link to other traceability systems such as trackers, trace elements and blockchain to provide an end-to-end authenticated product provenance story. These are discussed in more detail elsewhere in this report.

Case studies:

Providers:

Blue List

The technologies on the Blue List require a good understanding of digital technologies as well as reasonable competencies. They also typically require significant investment (time and money) and commitment from the leadership team to the operational staff.

As for any business investment decision, a business case with clear objectives, key performance objectives, and time frames should be developed and signed off at the highest level. Spending time thinking about and describing in writing (creating a systems specification) is also highly recommended. Finally, have a look at the shopping checklist for the critical questions you need to think about and ask.

Full Chain Traceability System

Full chain traceability means that each supply chain partner can identify the source and recipient of each traceable entity. This doesn't mean that every supply chain partner knows all the data related to the items. The emphasis is on proving that every supply chain member has done their job AND the information to demonstrate that can be accessed if needed.

As a minimum, this means that every item that needs to be traced (the traceable entity) has been allocated a globally unique identifier. In addition, all participants should have internal and external traceability systems that can communicate with each other so that the linkages are transparent and traceable.

A full chain traceability system includes the following:

- Input suppliers (packaging, ingredients)
- Internal transactions within a company
- Harvest locations/vessel
- Processing locations
- Packaging locations
- Storage locations
- 3rd party logistics providers,
- Company customers

As a product passes from one supply chain partner to another, the traceability system collects and records data points to perform real-time and ex-post tracking of a product's movement through the value chain from origin to destination. It usually involves several different technologies (hardware and software) that need to be connected. Some critical elements to this consider for this to be successful.

Product-data pairing

Product -data pairing is the physical attachment of product information to the product itself. This can be achieved with a barcode, RFID chip, QR code, or alphanumeric (human-readable) code that journeys with the product as it moves

through the supply chain. Under this approach, information about each product accumulates through each step, eliminating the problem of data attrition that occurs with internal traceability.

One up one down traceability

Record-keeping to track purchases (one up) and sales (one down) of all food products that move through a particular entity in the supply chain. Some countries require this process for product recall purposes, and it is usually part of a more extensive whole chain traceability system.

Interoperability

Interoperability refers to the ability of different information technology systems or software programs to communicate seamlessly to exchange and use data. For systems to be truly interoperable, they must have semantic (common meaning) and syntactic (standard format) interoperability. The shopping checklist includes several questions to ask technology suppliers about interoperability

Reporting

For any traceability system to be functional, you need to think about how you can access data and when. In the case of full-chain traceability and authenticity, this includes considering who can get access to which data. For example, you may want to keep some data confidential, or you may want to be fully transparent.

Case studies:

Providers:

Provenance verification

Several technologies based on the techniques developed as part of forensic science have been developed to verify the provenance of food. This is usually achieved using food analysis that can link the product to the unique soil or water signature of a region or to test claims of organic or free-range production. As there can be considerable natural variation and overlap between signatures from different areas worldwide, the first step in this technique is to establish a reference database.

The analysis can use stable isotopes, DNA, trace elements and other metabolomics or a combination of these to form a product origin “identity”. Due to the need to invest in a reference database, these techniques are typically done for a region, an industry group, a supply chain and/or for premium products. Having said that the financial benefits of proving provenance are also potentially high – making the investment worth it.

Australian Pork Limited has invested in the Physi-Trace™ program, which can trace back the origin of pork products to about 855 of all pig producers in Australia. The major benefits include increased market confidence in the integrity and traceability of

Australian pork and verification of country of origin and product label claims. For more information <https://aussiepigfarmers.com.au/pork/our-product-integrity/physi-trace/>.

Case studies:

Providers:

Integrated enterprise system

An integrated enterprise system usually includes connected technologies such as barcodes, readers, RFID tags, and scanners to record information related to products for traceability purposes.

Internal traceability

The ability of a company to both track and preserve information about individual batches or units as they move through its facility. The tracking and data preservation must exist throughout all internal processes, such as when a batch or unit is aggregated, disaggregated, transformed, transported or otherwise altered.

This integrated traceability system typically dovetails with a company's internal digital systems, such as financial, information technology, and inventory management systems. This level of integration will provide significant business benefits providing information about business efficiencies in addition to product traceability.

Customisation

While many integrated traceability systems are available "off the shelf," individual companies may wish to put their system together based on their specific needs.

Customised systems can include

1. Product authentication
2. Product tracking
3. Inventory management
4. Supply chain and cold chain integrity and performance management
5. Trading and marketing platform tailored to the required market

The major challenge associated with a customised system is data compatibility and connectivity between the ERPs employed by the supply chain partner companies.

Case studies:

Providers:

Grey List

The technologies on the Grey List require a good understanding of digital technologies as well as good internal business systems. They also typically require significant investment (time and money) and commitment from the leadership team to the operational staff.

As for any business investment decision, a business case with clear objectives, key performance objectives, and time frames should be developed and signed off at the highest level. Spending time thinking about and describing in writing (creating a systems specification) is also highly recommended. Finally, have a look at the shopping checklist for the critical questions you need to think about and ask.

Distributed ledger

A distributed ledger is a public, permanent, unalterable, and constantly updated digital file of encrypted transactions stored in multiple copies across a network of devices. Distributed ledgers are distributed databases with decentralised data management systems. Because every storage device has an exact and updated copy of the ledger, data can be verified, audited, and protected from fraud and tampering—an important feature when transactions occur among actors that do not know or trust one another. Blockchain (initially invented for the digital currency, Bitcoin) is one system that uses a distributed ledger in which transactions are stored as chained blocks of data.

Blockchain

Blockchain is literally digital information (blocks) joined together and stored in a database (chains). It is typically the backbone of modern traceability systems and platforms because it is a highly secure system for recording and transmitting digital information without being edited.

The block has three types of digital information:

1. Transaction information, e.g. time, date, amount
2. Who is participating or authorising the transaction using a unique digital signature?
3. A unique identifying code called a “hash”.

New blocks are always added to the end of the blockchain and includes the “hash” of the previous block. The block is then copied and placed on every computer in the network (this can be thousands and even millions in the case of cryptocurrency). Thus, each copy of the blockchain is identical and if a block is changed in any way, then a new “hash” code is generated. Spreading the information across a network of computers makes it extremely difficult to manipulate – a hacker would need to manipulate every copy of the blockchain on the network.

Studies have shown that there are significant benefits for food and agribusinesses to using blockchain-enabled platforms. These include:

- Improving collaboration across the supply chain helping to improve the way food is tracked, transported, and sold to customers and consumers. Accelerating the tracing of food from days and weeks to mere seconds helps enable precise and rapid recalls preserving consumer trust.
- Ensuring that all testing documentation certificates and audits are up to date and accessible through sharing information across the supply chain. Achieving greater transparency enables regulatory authorities to be more efficient and achieve more rigorous compliance.
- Increasing transparency can help retailers better manage the shelf life of products, strengthen safeguards related to food authenticity, and help reduce food waste.
- Enabling consumers to get to know their food better, including the source, production process and handling throughout the supply chain.

Case studies:

Providers: