



Business Innovation Observatory



Traceability across the Value Chain

Advanced tracking systems

Case study 40

Internal Market,
Industry,
Entrepreneurship
and SMEs

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1. Executive summary

More efficient value chain management represents a major strategic competitive advantage that a growing number of companies are looking for. Advanced tracking systems are one of the rising technologies that can make value chain smarter through the setting up of a fully networked business environment.

Advanced tracking systems are taking over the traditional practices, such as the barcodes. This is due to the restricted possibilities offered by traditional tracking systems, especially the limitations regarding the storage of information.

Advanced tracking systems intend to identify and track items along the value chain through the use of data transfer. A tag is attached to a specific item, whose every move and history can then be traced and logged. The two main communication technologies for transferring the data are Radio Frequency Identification (RFID) and Near Field Communication (NFC).

The global economy has witnessed a severe slowdown in the recent years, yet the market for advanced tracking systems has proved its high resilience and even sustained a strong growth. Both RFID and NFC markets are expected to maintain this increase, with the NFC market reaching EUR 16.16 billion by 2018, while the RFID market up to EUR 17.55 billion in 2020.

The substantial benefits brought by the advanced tracking systems are widely recognised and explain the strong performance of the market. Such systems have of course a particular strong effect on the value chain. They are capable of real-time pinpoint location and identification of items in production and warehouse area. Thus, they can reduce operating costs, optimise the efficiency of the current assets of a company, and even increase sales. Advanced tracking systems can also close some of the information gaps along the value chain. The same data can be captured from the source by suppliers to retailers and even end-users.

Another major benefit is the enhanced safety and security thanks to an improved traceability. Traceability corresponds

to the capability to seize, gather, and keep information in a way that allows easy traceability of the origin, location and life history of an item. It is already mandatory for certain sectors such as food or pharma. By enabling it, advanced tracking systems also represent a valuable guarantee for the end-users and for companies to avoid counterfeiting.

Numerous drivers are fuelling the growth of advanced tracking systems, but this case study will focus on three main drivers. The cost of implementing the systems have shrunk in the last years and have become affordable for most companies. These costs were pushed down by another driver: the harmonisation of standards across the field. For instance, the work of the European Telecommunications Standards Institute (ETSI) had a positive impact on the trend. Finally, EU regulations that push for more traceability have created sectors with early adopters.

Yet, the sound development of the advanced tracking systems is still hindered by several barriers. The low-cost needed for the mainstream adoption of advanced tracking systems requires limited computation resources, which was at the expense of security and privacy. However, the main barrier is related to the lack of experts in the domain. The recent explosion of tracking systems has created a skill shortage, as the number of specialists cannot meet industry demand.

The policy recommendations included in this case study are threefold. To tackle privacy and security matters, the legislation should reinforce its focus on data protection. High technology and digitalisation of the European economy, and more specifically industry, are vital for the competitiveness. Still, there is today isn't a go-to indicator to assess the adoption of technology in private companies. Such an indicator should be implemented by policy-makers to obtain a better understanding of the situation. Finally, on a more technical side, the spectrum frequencies used in Europe (mainly for RFID) induce some limitations for the sector. For example, it may not be sufficient for tougher conditions where humidity, water or steel could hamper the waves.



2. Advanced Tracking Systems

A growing number of companies are looking for an efficient and reliable way to track (following the progress of an item) and trace (trying to find where a missing item has gone). Gathering comprehensive information on every item they use is becoming more and more valuable to them. Indeed, it allows them to have a precise knowledge of their assets and to comply with regulations.

This case study is part of a series of three case studies on traceability across the value chain and focuses on the technological innovations that drive developments in advanced tracking systems. The second case study also concentrates on technological innovations, related to anti-counterfeiting. Finally, the third case study analyses developments in traceability across the value chain specifically through the lens of standards and processes.

Advanced tracking systems encompass solutions allowing to track and trace along the entire or part of the value chain, from supply to production to distribution, and even to the after-sales. For example, the fundamental principle behind the Track & trace services is that an identification tag is devoted to each item along the whole value chain. This tag will enable the tracking system, which includes: item identification; event capture as items move through the value chains, and management; information storage; and information sharing among authorized parties.

The implementation of such advanced tracking system necessitates the introduction of technological innovations at every step of the value chain. Two main auto-identification technologies are currently rising on the market: Radio Frequency IDentification (RFID) and Near Field Communication (NFC).

On the one hand, RFID (radio frequency identification) is a technology that permits to identify objects simultaneously in a fully automated manner via radio waves. This feature has allowed RFID technology to be applied for numerous purposes in the value chain, including supply chain management, production monitoring, and quality control for industrial manufacturing. Table 1 provides more details regarding the features of RFID systems by frequencies, while Table 2 presents the main difference between active and passive RFID systems.

Table 1: Features of RFID systems by frequencies

Frequencies	The size of the radio waves used to communicate between RFID system components
Low Frequency	<ul style="list-style-type: none"> - Short read range of 10 cm - Slow read speed - Low sensitivity to radio wave interference - Frequencies from 125 – 134 kHz
High Frequency	<ul style="list-style-type: none"> - Medium read range between 10 cm and 1 m - Include Near-Field Communication - Multiple competing standards - Frequencies of 13.56 MHz
Ultra-High Frequency	<ul style="list-style-type: none"> - Read range can reach 12m - 20x the range and speed of HF - Technology used for item tagging - Frequencies from 865 to 868 MHz

Source: PwC Analysis

Table 2: Different categories of RFID systems

Systems	Two broad categories of RFID systems
Active	<ul style="list-style-type: none"> - Tags have their own transmitter and power source - Typically operate in the ultra-high frequency (UHF) band
Passive	<ul style="list-style-type: none"> - Reader and reader antenna send a radio signal to the tag - Can operate in the low frequency (LF), high frequency (HF) or ultra-high frequency (UHF) radio bands

Source: PwC Analysis

On the other hand, NFC is more complex and secure. NFC is a specialised subset within the family of RFID technology. It is a short range wireless technology, but it can be used as one or two way communications. NFC is more relevant for applications where a physical touch or close distance is required, for security purposes.

Advanced tracking systems have the potential to heavily impact the value chain management. They cannot be considered as only a substitute for barcodes, as they largely complement them. In fact, they make sure that the right item is present in the right place at the right time, with no discrepancies and errors. This is why they are likely to replace the traditional optical identification solutions (like the barcode) in near future for most of the applications. The advanced tracking systems benefits from several advantages when compared with optical identification solutions: higher read rate (multiple tags can be read simultaneously), no mandatory line of sight, higher security, possibility to trigger event, and read/write capabilities.



The benefits of traceability for consumers, government authorities, and private companies are largely identified. The advanced tracking systems have the potential to impact every step of the value chain. Supply chains are significantly enhanced with improved efficiency and reliability. Real-time data allow adapting more precisely administration and planning processes. Manufacturing also gains from these new ways of anticipating issues to optimise its production quality and output. Finally, sales and after-sales are eased, thanks to simplified tracing of defect products, quick authentication of manufactured goods.

The regulatory push for more traceability supported the recent rise of advanced tracking systems. For example, food and pharmaceutical industries need to be able to detect and immediately recall contaminated product. Further, tightening security is also desired to fight product diversion, such as smuggling, counterfeiting and terrorism.

The low price of the silicon-based RFID tags is another main success factor explaining their current success. For instance, the passive tags do not require a battery: they gain their power from the electromagnetic field produced by the reader querying the tag. Their prices are affordable for extensive use, as the price range starts from only a few euro cents.

Table 3: Overview of the company cases referred to in this case study

Company	Location	Business innovation	Signals of success
Dipole	Spain	Focuses on Smart ID technologies, RFID, NFC and Advanced Systems.	<ul style="list-style-type: none"> - Partner of the Istanbul Nike Run 2014 - Smatrac, Motorola, Zebra, solution provider. - Industry key costumers: Siemens, ArcelorMittal - Special label manufacturer exporting to more than 30 countries.
Tracekey	Germany	Operates industry-specific cloud-based Track & Trace solutions	<ul style="list-style-type: none"> - Business partner agreement with BearingPoint - Winner of IT award of the NRW e.V.
Creativesystems	Portugal	Offers solutions for automatic identification and traceability that cover the entire projects' life cycle	<ul style="list-style-type: none"> - Works with Zara, world's biggest fashion retailer - Winner of Red Herring's Top 100 Global 2013 Award - Won Motorola Solutions Best Mobile Applications Solutions Award 2013 - Recognised PME Excelência 2012 - Received Innovation Award 2012
FractureCode	Denmark	Provides sophisticated Track & Trace systems combined with highly secure self-authenticating technologies	<ul style="list-style-type: none"> - Winner of PISEC06 and PISEC07 awards - Winner of EuroID 2007 award - Accredited Microsoft Silver Certified Partners - Codentify certified solutions provider

2.1. Presentation of the companies referred to in the case study

Problem 1 – There is a need to identify all items and get automated data input generated by the movements of products, goods and people in computer systems.

Innovative solution 1 – Dipole specialises in Smart ID technologies, RFID, NFC and Advanced Systems. It aims at bridging the gap between the physical world and the computer systems.

To do so, Dipole has developed a wide range of solutions that meet large market requirements, including RFID readers, antennas, tags, tags, software.

The company has not limited itself to asset tracking. It has also applied RFID technology for event management, which allow the clients to obtain real time registration (as in sport

events) or assistance verification and permission (congress and exhibitions).

Applying RFID technology for Event Management allow to obtain reliability for real time registration (as in Sport Events) or for assistance verification and permission (Congress and Exhibitions).





Dipole's RFID asset tracking systems can track containers, pallets, bins, and reusable transport items



Source: Dipole¹

Problem 2 – For most SMEs, advanced tracking systems are too expensive. Also, they often cannot afford buying multiple enterprise software solutions including Enterprise Resource planning systems. However, they still need to get on-board of the digitalisation to remain competitive.

Innovative solution 2 – Tracekey solutions is bringing track and trace solutions on the cloud in a cost-efficient manner. SMEs can benefit from tomorrow's digitalised value chain today.

Tracekey offers a full blown end-to-end solution, when most providers provides SQL database with limited capabilities. It includes data management (import and processing of large amounts of data in real time), representation and processing of product and packaging hierarchies.

Additional benefits of the Tracekey solutions lie in the possibility of collaboration along the supply chain. Indeed, the solution proposed by the company is aSoftware as a Service (SaaS) architecture. Thus, it enables full integration of suppliers and customers.

TraceKey helps SMEs digitalising their value chain and also offers mobile authentication capabilities

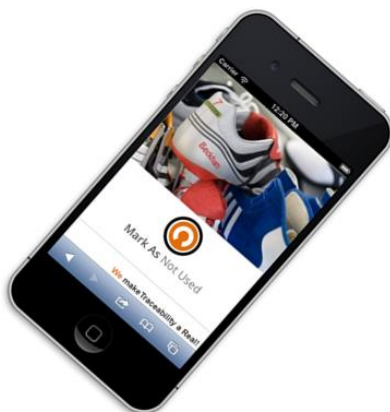


Illustration of Tracekey's end to end approach in Supply chain management



Source:Tracekey²

Problem 3 – Depending on the different sectors, companies do not have the same expectations from Advanced Tracking Systems. Systems must be adaptable to each sector.

Innovative solution 3 – Creativesystems creates and implements advanced solutions for automatic identification and traceability. It is possible to cover every stage of the projects' life cycle (design, hardware, software, services and support), at an item level from the source to the final customer.

Creativesystems has segmented its solutions in modules. The module selected for each case can thus be tailored depending on the uniqueness of the requirements set up by the client.

The solution is also highly scalable as proven by their current client portfolio. For example, the company is working with Inditex (whose flagship chain store is Zara), Adidas and eBay. It has a special emphasis in retail, logistics and manufacturing.

Creativesystems was acquired by Tyco Retail Solutions, a leading global provider of retail performance and security, on the 9 January 2015





Creativesystems participated in the development of the Shopping Cart of the Future



Source: Creativesystems³, Yahoo⁴

Problem 4 – With the increasing ease of globalisation comes the ever increasing problem of counterfeiting, diversion and local tax evasion of internationally traded products. Yet, there is a lack of solutions able to authenticate products.

Innovative solution 4 – FractureCode Corporation is a leading systems integrator and solutions provider in the field of Track & Trace, digital authentication and volume verification of manufactured items.

To fight the aforementioned issues of customer safety or counterfeiting, the aim of the company is thus to enhance

collaboration between governmental institutions and private companies. The firm believes that track and trace systems are an answer to these political and societal challenges.

This is why the company has developed a solution based on printing, security, vision systems, software and IT. The solution is based on the application of sophisticated secure codes generated in real time. It is integrated into the customers' existing infrastructures making it a very powerful tool, especially for industries that suffer most from these criminal activities. Hence, the markets targeted by the company are tobacco, alcohol or pharmaceuticals.

FractureCode serves customers in 35 countries across the globe from its Copenhagen based headquarters as well as regional offices in Dubai and Mexico City.



Source: FractureCode⁵

3. Socio-Economic Relevance

Since the late 2000's, the market has witnessed a era of quick growth and profitability, to reach maturity. Yet, there are dissimilar rates of growth for the diverse applications and still many challenges and opportunities still exist.

3.1. The market potential of the trend

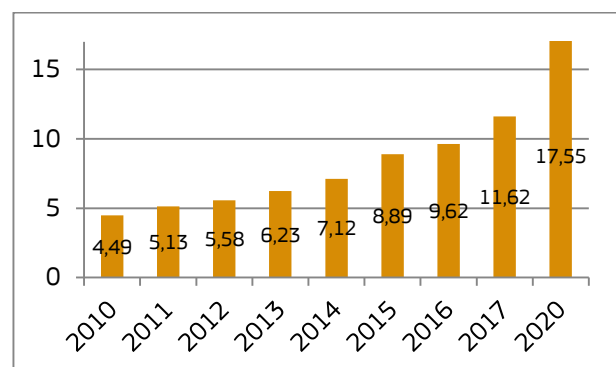
Despite the worldwide economic slowdown, the advanced tracking systems have shown continuous growth. This can be explained by its diverse types of applications. The industries which can apply the tracking systems are numerous and include activities related to transportation, security, retail, manufacturing, or healthcare. The types of use for tracking systems are also very diverse, such as tagging items, transport ticketing, livestock monitoring, and contactless transactions.

To assess the market potential of the advanced tracking systems, we will differentiate between the RFID and the NFC markets.

RFID market potential

In 2014, the global RFID market was worth EUR 7.12 billion, following a strong and steady growth from EUR 6.23 billion in 2013 and EUR 5.58 billion in 2012. The market is expected to reach EUR 17.55 billion in 2020. This includes tags, readers and software/services for RFID cards, labels, fobs and all other form factors.

Figure 1: Projected size of the global market for RFID tags from 2010 to 2020 (in EUR billion)



Source: IDTechEx Ltd

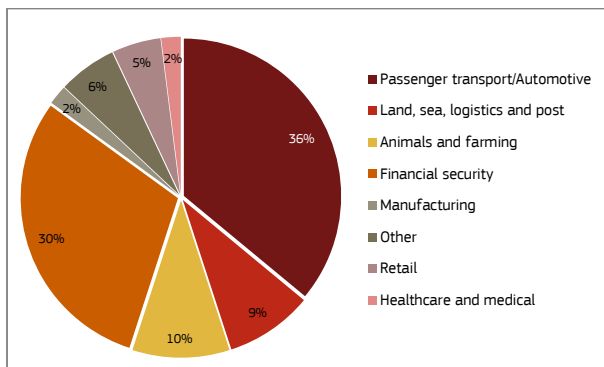


The RFID market is predicted to accelerate its high CAGR trend for the coming years, doubling its size by 2018, and continuing to double by 2024 to reach EUR 24 billion.

This growth will be driven by the retail sector, which will pursue an item-level apparel tagging. Such initiatives are already implemented by major US and European players like Macy's, Walmart, American Apparel or Zara. According to IDTechEx, a staggering amount of the 40 billion apparel items could be tagged each year, compared to only 3 billion tagged in 2014.

The sectors with the largest expenditure are currently going through a shift, as illustrated in Figure 2 and Figure 3. In 2014, governments were behind most advanced tracking systems orders, with the objective to improve safety (ID, passports, secure documents), efficiency (clickers, cards, smart tickets for passenger transport), and protection (identification of pets and livestock).

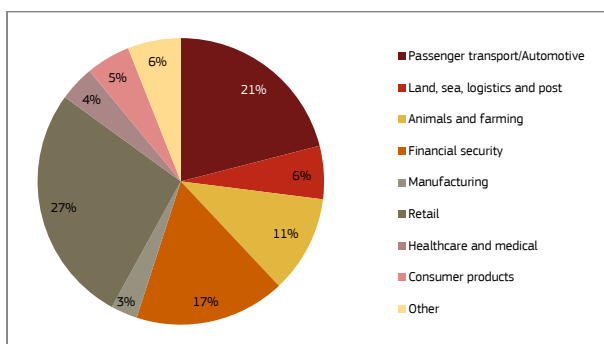
Figure 2: Markets by application in 2014



Source: IDTechEx Ltd

However, by 2020, it is anticipated that the private sector will lead with mainly orders for retail and consumer goods purposes (pallets/cases, apparel, items), as shown in Figure 3.

Figure 3: Markets by application in 2024



Source: IDTechEx Ltd

RFID suppliers are heavily fragmented. In 2010, there were more than 1000 suppliers, with the ten biggest sharing half of the market. Table 4 shows that Europe has already a strong position on the market. Three-quarters of companies above EUR 360 million of sales are coming from Luxembourg, Netherlands and Sweden.

Table 4: Companies leading the RFID market in 2010

Supplier	Origin	Market segment	Sales in EUR
Gemplus	LU	Smart cards and passports	> 450 million
NXP	NL	Chips	450 million
ACS	China	Road tolling, transport cards	450 million
Assa Abloy	SE	Secure access, livestock	360 million
Savi	USA	Military, logistics	180 million
Smartrac	NL	Passports	135 million
Allflex	USA	Animal and farming	90 million

NFC market potential

The global near field communication market was estimated at EUR 860 million in 2012. This is expected to reach a size of EUR 16.16 billion by 2018. A solid CAGR of 43.7% is anticipated for the forecast period.⁶

The implementation of NFC in smartphones and tablets is driving the development of the worldwide NFC market. NFC is now of the basic technology integrated in every smartphones and tablets, as a minimum specification. In 2013, more than 260 million NFC-enabled cellular handsets were distributed throughout the world.

As the market penetration of smartphones, mobile payments systems are also enabling the rise of NFC. Major actors in the smartphones industry and the banking sector support the rise of the contactless transactions by proposing NFC-based solution. Recently, solutions such as Google Wallet or Apple Pay received a lot of focus from the press.

Among all the product types, NFC readers were the largest segment in terms of revenue in 2012 and accounted for around 46% share of the total market, due to their higher sales prices. Growing adoption of NFC technology will also increase the demand for NFC readers in the coming years. NFC tags are finding significant demand in newer applications such as NFC marketing, games and toys, as well as healthcare among others. These new applications will drive the expected growth of NFC tags in the coming years.

The NFC market is segmented into three main types of products: controller ICs (chips), tags and readers that secure elements. The NFC readers represented the largest portion in term of revenue shares, with nearly 46% of the total revenues generated by the global NFC market. The reason behind this lead is the high sales prices of the readers.



The NFC has various applications in diverse industries. Payment with contactless transactions is currently the main application with 22% of the market share in 2012. It is then followed by ticketing and booking. Other sectors are rising strongly. Increased demand from games and toys, healthcare, and NFC marketing are being noticed. Yet, the fastest growing segment is related to security applications, due to the improved security functionalities provided by the NFC technology.

3.2. The social potential of the trend

Whenever a new technological advance is introduced, there is an impact of some jobs that are replaced by the technology. However, with the introduction of tracking systems, the macroeconomic balance sheet is clearly leaning on the positive side.

As advanced tracking system is implemented in more companies, the amount of jobs required for the monitoring of goods in warehouses, distribution centres and the backs of stores will be reduced. Meanwhile, a rising number of jobs will be created for developing, implementing, and maintaining RFID systems. A large number of indirect jobs can also be related to the development of tracking systems. A vast volume of data will be generated by RFID and NFC solutions. Their exploitation will also engender new jobs for highly qualified workers in IT services.

More than the creation of jobs, advanced tracking systems will result in the productivity gains. With regard to international competition, enhancing the competitiveness of European companies is of the outmost importance. Raising the productivity per capita is thus important for Europe to maintain its industry.

By hindering counterfeiting, the advanced tracking systems have a further positive indirect impact on the European economy. Counterfeited goods represent an inequitable competition for European companies, who loose potential sales opportunities. It thus harms the growth of companies contributing toward unemployment. Several sectors where Europe has a strong and leading position are severely impacted by jobs compression due to counterfeiting. Fashion and high-end products, such as textiles, garments, leather ware, shoes, watches and jewellery amount to over half the total value of imitation goods detained by customs.

Finally, advanced tracking systems also have a large impact on the quality and reliability of the products. The enhanced traceability is making them easier to recall. The social benefits of traceability also relate to health and safety. These types of risks are lowered for the products users, as counterfeits can be verified and defective products can be recalled quickly.

3.3. Impact of Advanced Tracking Systems on the value chain

A value chain needs to be continuous and unified to optimise its efficiency. Collaboration between the different stages of the value chain is thus a decisive factor for improving their processes. Making this collaboration possible is precisely what the advanced tracking systems technologies can offer when implemented.

The outcomes of an advanced tracking system are not limited to only the business implementing it. The generation of massive amounts of data will of course benefit the company thanks to process efficiencies, and even lower working capital needs. However, everyone from the suppliers to the end-consumers can exploit the information carried by the tags.

Almost all the segments of the value chain are impacted. First, the manufacturer can experience increased in operational efficiency and cost reductions as labour intensive tasks are performed quicker and with more precision. Further, manufacturers can also gather data from the tags, which can transmit more data than traditional barcodes. This big data can then be analysed and transformed into production processes improvements.

Secondly, the supply chain and logistics are also simplified thanks to the automation of data gathering. Implementation of advanced tracking systems can particularly bring improvements to the distribution. The technology quickens the management of delivery in several ways. When an identification method is embedded in a good, the readers of the distribution centre will know the required information to process it accurately. For example, the package can be stored at the right place, sorted quickly and efficiently, or moved with the level of care required. The unique identifier of the tags lessens also the margin of errors for wrong dispatching.

Thirdly, using advanced tracking systems also offers extremely accurate inventory. For example, whether the good is located in the warehouse of the supplier or in the store of retailer, they are scanned and registered automatically at the entrance and exits. It improves stock visibility and traceability, but can also have after-sales marketing application.

Hence, advanced tracking systems will not reshape the structure of the value chain. However, they have the potential to make it reach new heights in terms of efficiency.



4. Drivers and obstacles

The drivers explaining for the development of advanced tracking systems include the wide adoption of standards. Regulations also had a major impact at the inception of the technologies. On the other hand, the costs of the solutions were long seen as a hindrance, but this is slowly turning around as they keep shrinking. However, the recent importance taken by data privacy and the lack of skilled specialists are considered as the main risks, which could slow down the impressive growth of advanced tracking systems.

4.1. Cost of implementing advanced tracking systems

The costs related to the introduction of the advanced tracking systems were long time considered as the main barrier to their adoption. One of the most effective methods for inventory management in manufacturing or retail is the item-level tagging. Since its beginning in 2000, the RFID industry claimed that mainstream adoption would be ready when the tag cost went below EUR 0.05 for basic passive RFID.

With the continuous rise of the technologies, large amount of tags are produced every year, driving the costs of the silicon-based tags (which can store a unique serial number) below the awaited EUR 0.05. Further, with greater adoption of the technology, the greater the costs will fall. This decline in costs is highly likely to fuel even more the growth of the advanced tracking systems.

Only very specific sectors are still waiting for lower prices of tags. For example, for some low cost goods, such as fresh food (i.e. a salad can be priced below EUR 1), tags are still slightly too expensive. Indeed, they need to be more resistant to operate in tougher conditions than usual. The high level of humidity, required to keep the food fresh, absorbs part of the radio-frequency energy. The different substrates used for these tags are making them too expensive than what most farmers can afford.

4.2. Low range of frequencies allowed

Countries around the world have assigned different parts of the radio spectrum for RFID. This has resulted today in no single technology optimally satisfying all the requirements of existing and potential markets.

UHF bandwidth in the European Union can transmit from 865.6 to 867.6 MHz, with readers allowed to reach maximum power (2 watts ERP). In comparison to other regions worldwide, Europe offers the smallest range of UHF spectrum allotted for RFID applications. For example, in North America, the range is from 902 to 928 MHz.

4.3. Standardisation and harmonisation

To be widely adopted, advanced tracking systems need to be able to work across companies, sectors, and countries. Due to their impact across the whole value chain, developing international standards was an essential prerequisite to create a market open for all. This includes communication protocols, but also format of data, air interfaces for RFID and NFC technologies.

“Technology wise, we are fine”
– Tracekey

Hence, the diffusion of the auto-identification technologies has drastically amplified by regulations and the setting of worldwide standards. For example, Global Standard 1 is a neutral non-profit international organisation that develops and maintains standards for supply and demand chains. The Electronic Product Code (EPC) from GS1 forms the bridge between barcode-based identifiers and the world of RFID. Meanwhile, the ISO 11784 defines how data are structured on the tag. The widespread acceptance reached by these standards delivers a promising open architecture for tracking and tracing objects over the Internet and through the whole value chain.

The role played by the European Telecommunications Standards Institute (ETSI) was highlighted by the showcased companies for its overall positive impact on the international scene. The standards have allowed tracking systems to become almost fully interoperable today. The standards were the first step in a unified market, which led to a wider confidence in the technology, and ultimately a price decrease.

However, some improvements can still be introduced. The main one lies in ensuring that SMEs are more involved in defining the standards. Some companies interviewed for the case studies were under the impression that the standard definition process is mainly addressed to large companies and public institutions. One of the barriers highlighted in the interviews is that the process represents a high investment in terms of time and cost for SMEs.

“Policy-makers should not let proprietary standard drive the track and trace discussion” –
FractureCode



4.4. Regulations pushing for adoption of tracking systems

Regulatory compliance has acted as a major driver for the implementation of advanced tracking systems in some specific sectors. The EU Commission has introduced heavy requirements forcing industries to adapt.

For example, the "Track and Trace" Directive (EU food regulation No. 178/2002) is an initiative from June 2005,

"It is likely our company would not exist without the regulations" – **FractureCode**

which sets consumer safety as its first objective. The directive impacts every stage of food production, processing, and supply chain. This

directive compels companies active in food and beverages to maintain a comprehensive list of any items or substance which made contact with the final product.

Directives related to animal identification have also been introduced in multiple instances (latest in 2006 and 2010).

"The main driver for the food sector is coming from the legislation" – **Tracekey**

They lay down requirements for the identification and registration of bovine, ovine and caprine. Advanced tracking systems have

largely benefited from the traction created by these requirements, as seen in the market potential of the trend.

A similar approach was also introduced toward fish. Two major regulations implemented in 2008 (No 1005/2008) and 2009 (No 1224/2009) are aiming to tackle illegal, unreported and unregulated (IUU) fishing. They are setting up a Community system to protect European fishing by introducing a catch certification scheme. It focuses on improving traceability from the moment the fish is caught to the consumer.

4.5. Security and privacy concerns

The main fears regarding RFID and NFC technologies could be put in two main categories; security and privacy. Security

"The European legislation with regard to data protection is a problem" – **Tracekey**

concerns are related to legitimate readers obtaining data from illegitimate tags, while privacy concerns are related to illegitimate

readers obtaining data from legitimate tags.

From the client perspective, privacy topics are more predominant and have thus benefited from more media coverage. The topic of security is more contradictory: while advanced tracking systems add security (notably enhanced traceability), the very nature of these technologies engenders new risks.

With advanced tracking systems, retaining the information can prove complicated. Information leakage refers to when the tag exposes information that possibly is sensitive, that could be exploited to describe the accurate nature of the item.

Tags or NFC devices are readable without the consent and even knowledge of the owner, by anyone with an RFID tag or NFC reader. A RFID tag is not capable to differentiate between two readers. The contents of a tag can thus be accessed even after the initial purpose of the tag has been fulfilled. Moreover, RFID tags typically release an identification number or an alphanumeric called as a key. This can lead to unwanted tracking, where individuals are monitored without their consent, because of the goods they are using.

RFID reader/tag systems are intended to keep the distance between the tag and the reader to a minimum. Yet, ultra-high frequency (UHF) tags have a range up to 12m. With a high-gain antenna, tags can be read from an even longer distance. This is also relevant for NFC devices.

Eavesdropping is when a potential criminal deliberately listen to an NFC transaction. Gathering private data does not even require grasping the entire signal. However, the NFC user can prevent this by making sure that secure channels are used for the transaction. The data will be encrypted and only an authorised device can decrypt it.

4.6. Lack of specialist to support the demand

One of the major issues that companies face is the lack of skilled workforce. Advanced tracking systems are at the crossroad of engineering and coding. Also, advanced tracking systems are suffering of the competition of other IT intensive sectors. Skilled IT

"There are not enough people in the EU who understand RFID deployment" – **Creative Systems**

professionals tend to prefer focusing on mobile experience, and also on applications that will directly be used by the end-users. Advanced tracking systems are mainly directed toward B2B and thus are seen as less attractive for many IT experts.



5. Policy recommendations

5.1. Increase the spectrum of frequencies

In comparison with other competing regions worldwide, Europe currently has the lowest spectrum of frequency available for tracking systems. The European Telecommunications Standards Institute has allowed the frequency from 865.6 to 867.6 Mhz for RFID UHF band in Europe. This limitation is sometimes seen as a limitation for the development of European RFID.

Making more frequencies available should thus be considered as a priority. ETSI has developed a four-channel plan with additional frequency from 915 to 921 Mhz. This frequency range is closer to the other frequencies currently used around the world. Since transmission is also impacted by the environment (metals and humidity can have a negative impact), the transmission could also benefit from more powerful tags. Accelerating the implementation of these spectrums would help pave the way for a stronger European advanced tracking systems market.

5.2. Data protection legislation

While certain areas do not raise any data protection concerns, there are others which present significant menaces for the privacy of the end-users.

For example, a passive chip will receive the energy needed to be activated from the radio signals sent by reading device. Once activated, a passive chip will share its data with the read device. No authorisation is required as any device can reach the data.

Up to now, no tracking systems specific legislation, regulation or directives were enacted in Europe. Some initial work has been carried out by the European Data Protection

Supervisor, which include recommendation of legislation. However, it is important to reassure all stakeholders on the protection of their data.

Advanced tracking tags and readers must take into account the risk of eavesdropping or information leakages. Their design should aim at mitigating this risk with the introduction of security measures. If RFID and NFC providers are not taking actions to prevent these risks, policy-makers must take the matter into their own hands.

5.3. High technology indicator

European industry is currently living an era of digitalisation with many trends such as the rise of Big Data and Internet of Things, the cloud, and of course the advanced tracking systems. Several countries are also implementing programs to support them. For example, Germany has the Industry 4.0 plan, while the Netherlands has a similar initiative called “Smart Industry”. Advanced tracking systems have proved their added-value for manufacturing and industrial companies, who can see tangible results from their investments

However, there are limited indicators for policy-makers to follow and assess the progress of these trends. The creation of a high-technology indicator could help define the macro-economic progress more precisely. The economic relevance of advanced tracking systems and other trends could be analysed in more detail. This indicator could be a composite indicator created from existing ones. It would be comprehensive, taking into account the several steps and facets of smart value chain to ensure that a clear overall picture is drawn. Thus, such a valuable tool would lead to improved decision-making for policy-makers at European and national level, by providing factual data on the progress of smart value chains.



6. Appendix

6.1. Interviews

Company	Interviewee	Position
Creativesystems	Joao Vilaca	CEO
Tracekey	Gerald Wenzel	CEO
Dipole	Santiago Depares Aguilar	CEO
FractureCode	Jacob Juul Rasmussen	CEO

6.2. Websites

Creative Systems	www.creativesystems.eu
Tracekey	www.tracekey.com
Dipole	www.dipolerfid.com
FractureCode	www.fracturecode.com

6.3. References

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- ⁶ Transparency market research, "Near Field Communication (NFC) Market (By Products - Global Industry Analysis, Size, Share, Growth, Trends and Forecast, 2013 – 2019", Available at: <http://www.transparencymarketresearch.com/pressrelease/near-field-communication-market.htm>