Justification for the Supply chain applications of IoT suite (IoT/SC)

A.1 TC122 N622 Market relevance

Since 2008, there have been no fewer than 40 European Union funded projects that touch upon the Internet of Things.[1] In October, 2010, China's IoT market size was expected to top 200 billion yuan (about 30 billion U.S. dollars) and to top 750 billion yuan by 2015.[2] Intel Corporation predicts there will be 31 billion devices connected to the Internet by 2020.[3] In a statement to shareholders, the Ericsson CEO repeated the company's vision of 50 billion connections by 2020.[4]

However given the myriad of possible standards, it does seem that there is not really a uniform standard yet … The lack of a standard or multiprotocol support makes it hard to choose the right technology.[5] It is a known fact that two different devices might not be interoperable, even if they are following the same standard. This is a major showstopper for wide adoption of IoT technologies. Future tags must integrate different communication standards and protocols that operate at different frequencies and allow different architectures, centralised or distributed, and be able to communicate with other networks unless global, well-defined standards emerge … Governance, standardisation and interoperability are absolute necessities on the path towards the vision of things able to communicate with each other.[6]

IBM Research – Zurich points to logistics as being a major opportunity for IoT and IoT is considered to be a key enabler of applications and services across a broad range of vertical markets (e.g., health-care, logistics, transport, utilities, etc.)[7,8] The CASAGRAS Final Report notes, While originating from applications such as supply chain management and logistics, IoT now targets multiple domains including automation, energy, e-health etc.[9]

Information-technology (IT) firms have identified smart systems as the next big thing. Predictably, the most ambitious designs have been produced by the industry's giants, particularly IBM, where Sam Palmisano, the firm's boss, made smart systems a priority. A couple of years ago the company launched a campaign called "Smarter Planet", touting digital technology that would make energy, transport, cities and many other areas more intelligent. Other firms have followed suit, each with a different take reflecting its particular strengths.

Cisco, the world's biggest maker of networking gear, is trumpeting "Smart+Connected Communities". Hewlett-Packard, number one in hardware, intends to spin a "Central Nervous System for the Earth". Siemens and its competitor General Electric, which are more at home in the physical world, plan to put together lots of smart systems in which they can deploy their deep knowledge of certain industries, such as health care and manufacturing. And there is a growing wave of "smart" start-ups, offering everything from services to pinpoint a device's location to platforms for sensor data.

Governments, too, have jumped on the bandwagon. Many countries have been spending large chunks of their stimulus packages on smart-infrastructure projects, and some have made smart systems a priority of industrial policy. The "internet of things", another label for these systems, is

[1] http://www.internet-of-things-research.eu/partners.htm
[2] http://news.xinhuanet.com/english2010/business/2010-10/29/c_13580705.htm
[3] http://newsroom.intel.com/docs/DOC-2297
[4] http://www.ericsson.com/thecompany/press/releases/2010/04/1403231
[5] OECD (2012), "Machine-to-Machine Communications: Connecting Billions of Devices", OECD Digital Economy Papers, No. 192, OECD Publishing. http://dx.doi.org/10.1787/5k9gsh2gp043-en
[6] http://www.iot-visitthefuture.eu/fileadmin/documents/researchforeurope/270808_IoT_in_2020_Workshop_Report_V1-1.pdf
[7] http://www.gse.org/Portals/2/docs/Belgium/Region%20Conference%202012/C08_The_Internet_of_Things_DataClouds.pdf
[8] http://www.itu.int/en/ITU-T/focusgroups/m2m/Documents/ToR/FG%20M2M%20-%20ToR.pdf
[9] http://www.grifs-project.eu/data/File/CASAGRAS%20FinalReport%20(2).pdf

central to the European Union's “Digital Agenda”. The main contenders in this market are countries that are strong in manufacturing, above all Germany and China.

But the bandwagon is not just rolling for the benefit of technology companies and ambitious politicians. It has gained momentum because there is a real need for such systems. In many countries the physical infrastructure is ageing, health-care costs are exploding and money is tight. Using resources more intelligently can make taxpayers' money go further. Monitoring patients remotely can be much cheaper and safer than keeping them in hospital. A bridge equipped with the right sensors can tell engineers when it needs to be serviced.

China is a good example. It is becoming urbanized on a scale unprecedented in history. By 2025 an additional 350m Chinese—more than the current population of the United States—will have moved to cities, according to a study by McKinsey, a consultancy. Without an infrastructure enhanced by digital technology it will be very hard to provide the country's newly urbanized population with enough food, transport, electricity and water.

Most important, smart systems may well be humankind's best hope for dealing with its pressing environmental problems, notably global warming. Today power grids, transport systems and water-distribution systems are essentially networks of dumb pipes. IBM calculates, if the power grids in America alone were just 5% more efficient, it would save greenhouse emissions equivalent to 53m cars. . In 2007 its congested roads cost the U.S. 4.2 billion working hours and 10.6 billion litres of wasted petrol, according to the Texas Transportation Institute. And utilities around the world lose between 25% and 50% of treated water to leaks, according to Lux Research, a market-research firm.

With so much to gain, what is there to lose? Privacy and the risk of abuse by a malevolent government spring to mind first. Indeed, compared with some smart systems, the ubiquitous telescreen monitoring device in George Orwell's novel “1984” seems a plaything. The book's hero, Winston Smith, would soon have a much harder time finding a corner in his room to hide from Big Brother.

Second, critics fear that smart systems could gang up on their creators, in the way they did in “The Matrix”, a 1999 film in which human beings are plugged into machines that simulate reality to control humans and harvest their bodies' heat and electrical activity. Fortunately, such a scenario is likely to remain science fiction. But smart systems might be vulnerable to malfunctioning or attacks by hackers.

Third, some people fret that those with access to smart systems will be vastly better informed than those without, giving them an unfair advantage.[10]

Many of these forecasts point to applications in areas such as Smart Grid, Smart City, Smart Logistics, Smart Home, Smart Car, Smart Enterprise, Smart Campus, Smart Environment, Smart Healthcare, Smart Transport, Smart Living, Smart Retail; however the standards envisioned in the proposed suite of standards would address only the issues of Smart Logistics and Smart Retail; and to some extent the Smart Home (re-ordering of products) Smart Enterprise (use and re-ordering of raw materials and supplies), Smart Healthcare (product use, re-ordering, and safety)), Smart Environment (potential recycling applications), Smart Living (use and content of products).

[10] http://www.economist.com/blogs/schumpeter/2010/12/internet_things

A.2 Subjects to be standardized

The suite of standards proposed include:

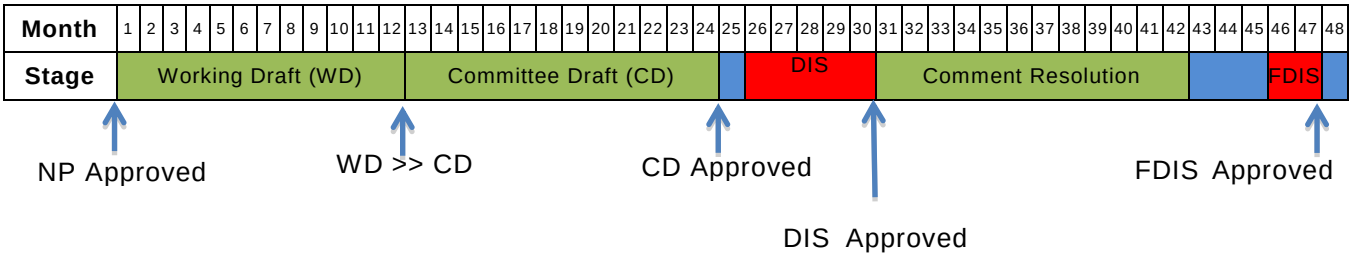
- *Supply chain applications of IoT — Products and product packaging*
- *Supply chain applications of IoT — Transport units*
- *Supply chain applications of IoT — Returnable transport items*
- *Supply chain applications of IoT — Containerized cargo*

Within each of these standards it is proposed to standardize the AIDC techniques appropriate for that standard:

- defined communication options for various settings
  - Wireless Body Area Networks (WBAN),
  - Wireless Personal Area Networks (WPAN),
  - RFID Networks, Local Area Networks (LAN), and
  - Wireless Wide Area Networks (WWAN)
  - 3G, 4G, LTE
- defined methods to secure localization and tracking
  - GPS,
  - GPRS,
  - RTLS,
  - resolution,
  - inertial navigation
- the appropriate devices for the standard, including
  - linear bar codes,
  - 2D symbols,
  - RFID,
  - sensors/motes/actuators,
  - smart phones
- defined methods of unique identification,
  - byte-oriented
  - bit-oriented
  - IPv6
- defined means to store and process the data, and
  - terminal applications
  - resident device storage
  - database storage
  - cloud storage
- the security necessary to protect the data for
  - authenticity,
  - validity, and
  - privacy perspectives.

A.3 Target dates

The proposed timeline is an Extended 48-month project development. Parallel activities are expected in groups such as a proposed JWG SWG IoT, a proposed JTC 1/SC 31/WG 8 on IoT, as well as developments among the telecom operators (3GPP) for Universal SIM cards. If the underpinning standards are developed more quickly in these parallel groups, the time line for this suite of standards may occur more quickly as well.



A.4 Relevant documents at the international, regional, and national level

See Annex A.

A.5 Relation to and impact on existing work

A.5.1 How work differs from Supply chain applications of RFID

RFID is an integral part of Internet of Things for the Supply Chain (IoT/SC), however, it is not the only part and may not even be the major portion. The largest concentration of IoT in September 2012 can be found in the mobile phone scanning of QR Codes. The RFID concepts contained in the 1736x series will be used in the IoT/SC series and built upon.

A.5.2 How work differs from Working Group on sensor networks

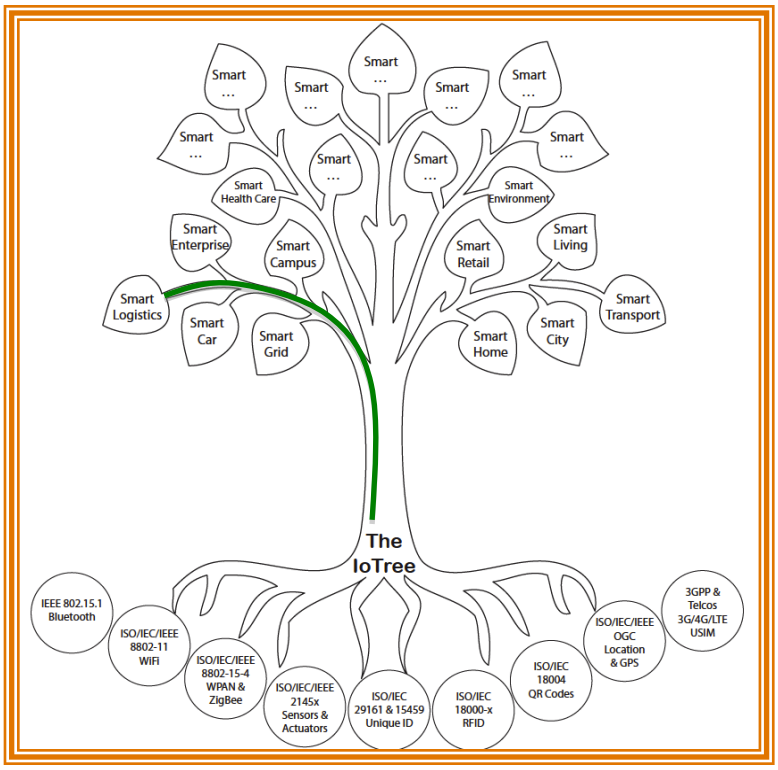
Again, IoT/SC is broader than sensors and sensor networks encompassing optically readable symbols as noted above, RFID, location based service, and true sensor specifications. The definitive standards on sensors are found in the 2145x series developed in IEEE TC 9 (IEEE 1451) and JTC 1/SC 31/WG 6. The JTC 1/WG 7 documents have no requirements and are little more than technical reports and white papers, regardless of whether they are called standards.

A.5.3 Why this work belongs in ISO TC 122

ISO TC 122 has long written “Application Standards” such as are found in 122/WG 4 (ISO 15394), 122/WG 7 (ISO 22742, ISO 28219), and 122/WG 10 (1736x), taking the technical and data standards developed by other committees (most notably JTC 1/SC 31) and applying supply chain relevance around these externally developed standards. It is important to understand that what is being proposed in the suite of four standards

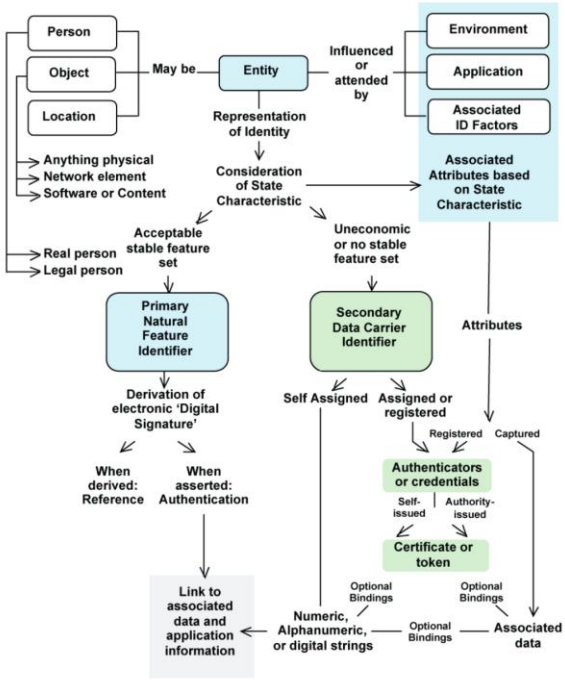
- *Supply chain applications of IoT — Products and product packaging*
- *Supply chain applications of IoT — Transport units*
- *Supply chain applications of IoT — Returnable transport items*
- *Supply chain applications of IoT — Containerized cargo*

… is not the entirety of IoT standards, but simply the supply chain applications of the Internet of Things. The figure below provides a pictorial description of the Internet of Things tree (IoTree).



… and as can be seen above, Smart Logistics/Smart Supply Chain is but a single branch of the IoTree, all however building on the same root structure.

From a supply chain perspective, ISO TC 122 is being asked to build on the concepts of item identification (or entity identification) as can be seen in the figure below



So IoT/SC is not intended to address the Smart Grid, or Smart Transport, or Smart Cars, or Smart Homes. IoT/SC is addressing the applications of IoT in the supply chain. And as the Supply chain applications of RFID belonged and were developed within ISO TC 122, so should the Supply chain applications of IoT.

A.6 Relevant country participation

A.6.1 Where proposal subject is important to specific national interests

- ETSI has been working on M2M standardizations and is considered to be ahead of other groups
- TIA TR 50-1 is the group that is driving M2M standards in the United States. There is also a smart device security ad hoc group subcommittee.
- CCSA in China has a TC 10 initiative for M2M
- Recently a new group, oneM2M, was established with the following groups as charter members: Association of Radio Industries and Businesses (ARIB) and the Telecommunication Technology Committee (TTC) of Japan; the Alliance for Telecommunications Industry Solutions (ATIS) and the Telecommunications Industry Association (TIA) of the USA; the China Communications Standards Association (CCSA); the European Telecommunications Standards Institute (ETSI); and the Telecommunications Technology Association (TTA) of Korea.
- To support long term development of IoT, the Ministry of Industry and Information Technology (MIIT) has released China's 12th Five-Year (2011-2015) Plan for IoT at a national level. This will enhance the capability of core technologies R&D, study and formulate key standards, set up and complete the industry chain, and support nine major applications, which are Intelligent Industry, Intelligent Agriculture, Intelligent Logistics, Intelligent Transportation, Smart Grid, Intelligent Environmental Protection, Intelligent Security, Intelligent Medical Treatment, Intelligent Home. The Ministry of Commerce and Ministry of Finance invested ¥4 billion for a food tracing system covering 36 cities in 2011, to plan and construct a central, provincial and city level tracing and management platform.[11]
- One Korean Ministry responsible for the manufacturing industries in Korea has noted the visionary goal is to make RFID/USN penetrate everyday life of people to deliver a better quality of living. Large demand areas of RFID were identified: alcohol/liquor, medicine, food, apparel, home appliances, parcel delivery, and car. Smart phones may be a ubiquitous terminal for reading RFID tags everywhere.[11]
- In Finland (and elsewhere) the deployment of the IoT is driven by telcos and mobile communication equipment manufacturing companies, it is likely that the first wave of IoT relies on (mobile) telecommunication technology including M2M solutions using SIM cards for identification and security and GSM, GPRS, 3G and 4G technologies for the communication infrastructure. The telcos will have a significant role in opening the market due to their large customer base and ability to manage complicated billing systems. Major deployments are expected in such fields as remote metering, security and safety applications, intelligent traffic systems, retail and logistics, remote management of buildings and facilities as well as intelligent machines. Helping the elderly to live independently is seen as an

[11] *The Internet of Things 2012 New Horizons*, IERC - Internet of Things European Research Cluster 3rd edition of the Cluster Book

important application area for the future. Experience and competences in communication technology as well as a strong base with certain industries gives the Finnish industry good position in entering the IoT business. [11]

— Application-oriented research characterizes German IoT activities. Research institutes and universities as well as companies and associations aim at the development of business models, tools and strategies for future products and services enabled by the IoT. Within the scope of the AUTONOMICS project the BMWi funds the development of a new generation of smart tools and systems that are able to network via Internet, identify situations, adapt to changing operating conditions and interact with users on their own. With this initiative, the Ministry wants to promote research and development activities to speed up the development and broader use of ICT-based technologies and services along the whole supply chain to enhance the autonomy of user systems. Sub-projects, such as AGILITA, DyCoNet and AutoBauLog, are three examples for application-oriented research activities funded in the scope of AUTONOMICS: AGILITA aims at the development of a flexible and efficient materials flow system for use in production in small and medium-sized enterprises (SMEs) The research aim is to respond quickly to rapidly changing market situations and shrinking product lifecycles by means of flexible production capacities. DyCoNet aims at the development of new solutions to improve the general availability of logistics data in dynamically changing and international supply networks. The project aims to utilize technologies, such as GSM/UMTS and GPS, for the transboundary networking of logistic objects. This allows the energy of self-sufficient logisitic objects, such as containers, packages and documents to autonomously communicate with each other to create an autonomous material flow. AutoBauLog aims at integrating building machines in large civil engineering construction projects. The building machines are equipped with sensors, communication devices and intelligent software to cooperate with other ‘machine team members’ and to autonomously proceed to the machine-based construction processes. As a result enabling self-organisation allows building machines to respond to their current situation, improves the machines’ utilization and thus, accelerates construction projects. Next to research activities German companies autonomously explore the IoT. Companies build up the necessary knowhow and develop intelligent products based on IoT usage. For many companies this means, that they have to enter new markets and fields of activities. One example for German corporate activities in the field of IoT is the German automotive supplier Bosch. Bosch have invested more than ten million Euro in a software company and currently seek other suitable ventures. Fostering the software development for intelligent products was announced as the goal of these activities. In future, Bosch plans to connect not only cars, but household items, such as fridges to the internet. Bosch wants to do the programming for these future products independently from other actors. There are other companies that prepare their products for use in the IoT. SAP in cooperation with the Deutsche Post; BMW with a freight container that documents and communicates the inside temperature; Siemens is exploring the development of machines, that autonomously create maintenance orders. [11]

A.6.2 Where proposal subject is important to specific non-P-member countries

— GISFI in India is working to harmonize with global standards, yet also achieve India-specific use case needs, such as food supply chain. The Global ICT Standardisation Forum for India (GISFI) has been set up with a vision to be an ICT standards forum in India. It plans to develop standards to meet the Indian requirements, as well as contributing to the evolution of global standards. The Internet of Things (IoT) is one of the many themes of focus for standardisation in GISFI. [11]

— Africa: If we look at the whole region, we might say that Africa is likely to be slow in the uptake of IoT technology compared with European and other developed countries, but if we scrutinize African countries separately we find interesting success stories from Africa that show Government awareness of the benefit of IoT to society, economy and environment. While all the applications described here are not IoT/SC, many are.

- The Tunisian Government, for example, has recently showed its strong commitment to institutionalize a national Research-Development-Innovation (RDI) program that responds to the evolving needs of ICT market with respect of Tunisian context. The underlying program stresses three priorities in terms of technologies and infrastructures: future network, Internet of Things and Internet content and recommend the Smart City, among four application domains. South Africa, also, has quickly recognized the importance of IoT and demonstrated how IoT applications could impact on energy conservation and load optimization, environmental control and inclusion, information dissemination to society, etc. In addition, various small-scale IoT initiatives across the African continent have been proposed to respond to specific needs of African people.
- For instance a Tanzanian logistics firm is currently employing an RFID-based system to help assure the distribution of oil products to its proper customers in East and Central Africa.
- Nigeria has recently launched a product verification initiative, via RFID, in an effort to secure the integrity of the drug supply chain and reduce the counterfeiting of drugs.
- It is expected that IoT adoption will be increased in the coming years and supply chain management is expected, among the sectors, to increase Africa's demand for RFID applications. Additionally, wireless sensor technologies have also brought effective solutions to healthcare, natural disasters, and environment control – which are the major problems faced in Africa.
- For example, in Ethiopia a health application was developed to monitor antiretroviral drug therapies for AIDS. A research group in Kenya developed an application based on heat sensors to detect a fire and automatically relays the information to a forest station through mobile phone technology to limit fire disasters. A system to monitor water quality in Malawi is under development at the Royal Institute of Technology in Sweden.
- Although existing initiatives show that IoT offers green field opportunities to Africa's needs across all sectors (supply chain management, healthcare, environment monitoring, etc.), the

adoption of IoT technologies remains very slow. Investigations on the barriers that hinder the adoption of IoT are needed and the way to leverage from successful experiences should be also considered.

- Existing technology research in South Africa is providing important enabling building blocks for IoT. These include: the South African Nano Technology initiative and the associated National Centre for Nano-structured Materials; the Sensor Science and Technology Group in the CSIR Materials Science & Manufacturing unit, conducts research in smart structures and materials, electro-optic sensing and imaging, and ultrasonics. The CSIR Meraka Institute's Advanced Sensor Networks Group, with the University of Pretoria, conducts research in wireless sensor network architectures and protocols. The CSIR Meraka Institute's Earth Observation Science and Information Technology Group has developed capability associated with Sensor Web Enablement of Earth Observation Data Resources. Recognition of the national importance of IoT led to a strategic intervention: the formation of the Internet of Things Engineering Group (IoTEG) at the CSIR Meraka Institute. IoTEG is positioned to leverage the mentioned enabling building blocks with the aim of building a national IoT competence. [11]

A.7 Cooperation and liaison

A.7.1 List of internal bodies where liaison will be sought

— JTC 1/SC 31
— JTC 1/WG 7
— ISO TC 211
— ISO TC 51

A.7.2 List of external bodies where liaison will be sought

— OGC
— 3GPP
— ETSI
— oneM2M
— JCA-IoT

A.7.3 List of potential points of conflict with other bodies

While there is, in fact, no conflict it is expected that that ISO TC 104 may claim that *Supply chain applications of IoT — Containerized cargo* conflicts with their remit for the same reasons that they have claimed that ISO 17363 conflicts with their remit. They have technology to track freight containers, which 17363 does not conflict. They have technology to secure the doors of freight containers, which 17363 does not conflict. They have a new proposal for a Container Tracking Device (CTD) that includes sensors, which come close to conflict, for there is no reason to incorporate sensors in the tracking of the container. TC 122, in both ISO 17363 and the proposed *Supply chain applications of IoT — Containerized cargo* is tracking the cargo, not the container. This is an important distinction because in both 17363 and the new proposal, TC 104 attempts to distance the carriers of the freight containers from any responsibilities for the CTD devices or their use. The original remit of TC 104 was for freight containers, their construction, size, corner fittings, testing,

structural integrity, coding and identification. In 2004 they began work on container seals, which then grew to electronic container seals. After ISO 17363 was developed they established ISO 18186, intended to directly compete with 17363. Again, TC 122 has no issues with their efforts to track freight containers, empty or filled. However, it is TC 122 that is responsible for the tracking of the cargo (the items, their packaging, and unit loads). TC 122 has a rich history of cooperation with ISO TC 51 (Pallets). It is anticipated that this cooperation will continue in IoT/SC. Regrettably, the same cannot be said for TC 104.

A.7.4 List of communications having occurred with other bodies

- JTC 1/SC 31
- JCA-IoT
- AIM

A.8 Affected stakeholders

A.8.1 Small and Medium-Sized Enterprises (SME) impact

- See A.6.1 discussion in Germany

- IoT is an emerging technology, with increasing opportunities for smaller companies and industries. Components of IoT have become more accessible, user friendly and most importantly, better in returning investment after adoption.

- IoT is far more than advanced bar code and GPS linking. IoT is complex, individual to the adopter and their environment, and it requires careful long term planning.

- IoT systems do require a substantial investment package (money and time) but when managed with commitment they will return on investment surprisingly quickly and in a multitude of ways.

- IoT provides the management tools and data to update and transform a business and it's processes. IoT can save companies money, drive profits and positively affect a business supply chain or management controls.

- Not all businesses or operations can justify the expense of an enterprise-wide system, particularly if SMEs are to become able to implement and benefit from the Internet of Things. In the future, an SME might employ the Internet of Things in some novel manners:

- As with looking up web pages currently, the SME could keep an information system that previously accessed the Internet of Things on a local cache.

- If the SME uses out-sourced data storage on the "cloud", then any resolving functions for the IoT might be transferred so that the cloud-based system actually invokes the resolving process for the IoT information

— In a study of SMEs in both logistics and manufacturing in China the following SWOT (Strength, Weakness, Opportunities and Threats) analysis was developed for SMEs and IoT.[12]

Strength	Weakness
E-business has been comprehensively adopted	Lack of product innovation
IoT technology is primarily adopted by logistic companies because of its outsourcing activities	Lacking of core competence, the products are similar in the market.
Higher brand awareness	Low quality service and lack of transportation facilities
Reach the customers in larger areas	
Customer information tracking and market prediction	
Provide product support and information via intern	
Opportunities	**Threats**
A great change of lifestyle brings revolution of business	Difficult to predict the economic prospect
Political factors such as special policies for supporting IoT technology development	Country law and regulation are not sound enough
IoT technology assists work flow visualization and perfection and supply chain management innovation	Weakness of information basis

SWOT Analysis of Logistic Companies

Strength	Weakness
Their business supported by several big customers	E-business is not popular
	Lower brand awareness
	Customer resource with geographic restriction
	Lack of customer information tracking and market prediction
	High purchasing cost
Opportunities	**Threats**
IoT allows them to lower the cost	Financial crisis
IoT supports the companies fulfill their mission	Higher environmental pressures
	Standardization is difficult to achieve
	The bottleneck of core technology
	Low degree of the network security

SWOT Analysis of Manufacturing Companies

According to the findings most logistics companies realize that IoT will bring revolutionary change.

When mentioning the concept of IoT, people connect it with logistics more closely, believing that logistics equals to IoT. So the researchers conclude that the logistics area is the primary test field in IoT development. They believe that IoT can make a substantial difference in the logistics industry, moreover, this effect is systematic for logistics. The main reason is that the technologies of IoT are a revolutionary innovation of information technology. There is no denying that the support of information technology is necessary for logistics industry.

Based on their survey of logistics firms, they agree that IoT brings "revolutionary" change to SMEs. Particularly, IoT certainly will bring intelligent logistics distribution network and supply chain change. Furthermore, the visibility of items in logistics management system

[12] *Strategy Development of SMEs in the Internet of Things era: Case Study on Chinese Enterprises,* Department of Industrial Engineering and Management, University of Gävle,

becomes clear. From their perspective, the revolutionary performance will be presented as follows:

- Firstly, the integration of information resources in the internal enterprise, the logistics firms try to achieve optimization of key business applications by internal information integration technology.

- Secondly, supply chain integration. In recent years, competitive pressure made domestic manufacturers and logistics enterprises cooperate in the upstream and downstream of supply chain to increase integration of resources, for example, some large Chinese logistic companies start to establish a data exchange platform.

- The last but not least, is the integrated logistics information platform. IoT in the logistics industry, integrate resources, markets, and information to promote the commercialization of information.

According to the researcher's understanding, pallet and container logistics industry may be the first application of IoT, and is the broadest and most effective area. First, the pallet was used commonly in logistics field. If the pallet employs electronic tags, the data are not collected from the contained product one by one, but can be calculated according to the whole pallet. Therefore, that it is easier to collect data. Furthermore, the data transmission becomes straightforward on the transport process.

For the logistics SMEs, they are mainly helping many types of customers to delivery their products. Their products provided to the customers are similar in the market. In order to maintain business in the heated competitive market, they have to develop a strong sales team and keep long-term customer relationship. Thus, all the marketing strategies and the IT tools, which could help them develop customers, are fully used by them.[12]

A.8.2 Small and Medium Sized Enterprises (SME) benefit

- Used by us all, it is in car key fobs, tickets, public transport payment schemes, retail supply chains, farming and much more. It will continue to feature in gadgets and European projects – under the Internet of Things.
- IoT is rapidly developing, combining other technologies like GPS and A-GPS for more effective tracking and tracing. This can be used, supplied, developed or supported by SMEs across the business sectors. The Internet of Things is all about items connecting and communicating with each other in a large-scale network – giving everything an identity.
- Businesses that invest in the technology and its solutions can benefit from impressive tracking, tracing, auditing and control measures. Tag/Sensor/Location-enabled items and assets can be monitored, controlled and thus stock, inventory or fleets (of staff or vehicles) can be maximized and sales improved. IoT also helps to improve business processes, performance and much more.
- RFID, sensors, and location-based systems have dropped considerably in costs and is now in the SME take-up stage, making it a viable option and solution for smaller companies, with good ROI.

— SMEs could supply IoT hardware, software, complete solution packages (including networks and infrastructure), architecture, project management, support, training and other services.
— As more governments deploy large-scale projects (like Transport for London's Oyster Card and Self-Check In Library systems) SMEs could be included in the project deliveries, support and deployment integration.
— IoT solutions include the tackling and advancing of health and safety recording, inventory loss and theft, asset tracking, tracing and real time automation and much more. There are many supporting opportunities.

A.9 Identification of Project Leader

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A.10 Purpose and justification of the work items

A.10.1 Supply chain applications of IoT – Products & product packaging

For more than a decade ISO TC 122 has written standards addressing linear bar code symbols, two-dimensional symbols, RFID, and the basics of sensor technology for products and product packaging. It is now possible to provide any time connection from anywhere to anything through the use of IoT technology. Sensors are able to continuously monitor the environmental conditions surrounding products and packages, providing alerts if and when the item's recommended parameters are not met. Products and packages that are outside certain environmental parameters may be continuously monitored as to their specific locations, alerting the owner when they go outside of those designated parameters. The combination of optically readable media, mobile phones, Internet connectivity, and the location of the mobile phones can access competitive pricing of items as well as being able to provide instant identification of the remaining shelf-life of a product prior to purchase.

IoT connectivity with products and product packaging can also enable better product identification by disabled individuals through mobile phones.

The need exists within all IoT applications to define the means to achieve any time/any where/any thing connectivity.

Failing to achieve a common means of IoT implementations can raise the cost of product design and the lack of an international solution can provide a barrier to trade

A.10.2 Supply chain applications of IoT – Transport units

For more than a decade ISO TC 122 has written standards addressing linear bar code symbols, two-dimensional symbols, RFID, and the basics of sensor technology for transport units. It is now possible to provide any time connection from anywhere to anything through the use of IoT technology. Sensors are able to continuously monitor the environmental

conditions surrounding transport units, providing alerts if and when the content's recommended parameters are not met. Transport units can be continuously monitored as to their specific locations, alerting the owner when they go outside of their defined range of environmental parameters. The combination of sensors, RFID, mobile readers, internet connectivity, and the location of the mobile readers can access and immediately monitor the condition of the contained product alerting material handlers in a first expired, first out inventory pick methodology.

The need exists within all IoT applications to define the means to achieve any time/any where/any thing connectivity.

Failing to achieve a common means of IoT implementations can raise the cost of product design and the lack of an international solution can provide a barrier to trade

A.10.3 Supply chain applications of IoT – Returnable transport items (RTIs)

For more than a decade ISO TC 122 has written standards addressing linear bar code symbols, two-dimensional symbols, RFID, and the basics of sensor technology for returnable transport items. It is now possible to provide any time connection from anywhere to anything through the use of IoT technology. The use of location-based technologies, combined with Internet connectivity, and mobile phone-like communications are now able to permit an asset owner to identity where that asset is located, anywhere in the world, by simply calling the asset. Likewise, if an asset is exposed to environmental conditions beyond those defined, by introducing sensor technology, the asset is able to call the asset owner, advise of its condition, and report its location.

The need exists within all IoT applications to define the means to achieve any time/any where/any thing connectivity.

Failing to achieve a common means of IoT implementations can raise the cost of product design and the lack of an international solution can provide a barrier to trade.

A.10.4 Supply chain applications of IoT – Containerized cargo

For more than a decade ISO TC 122 has written standards addressing linear bar code symbols, two-dimensional symbols, RFID, and the basics of sensor technology for containerized cargo. It is now possible to provide any time connection from anywhere to anything through the use of IoT technology. The use of location-based technologies, combined with Internet connectivity, and mobile phone-like communications are now able to permit a cargo owner to identity where that cargo is located, anywhere in the world, by simply calling the cargo. Likewise, if the cargo is exposed to environmental conditions beyond those defined, by introducing sensor technology, the cargo is able to call the cargo owner, advise of its condition, and report its location.

The need exists within all IoT applications to define the means to achieve any time/any where/any thing connectivity.

Failing to achieve a common means of IoT implementations can raise the cost of product design and the lack of an international solution can provide a barrier to trade.

A.11 Business, technological, societal or environmental issues

- From a business perspective the IoT/SC suite of standards permits owners of products, packages, and assets to instantly identify their location, condition, and surrounding environment.
- From a technological perspective the IoT/SC suite of standards combines the standards of optically readable media, RFID, sensors, actuators, location-based devices and services, mobile terminals, the widest range of wired and wireless communication, unique identification, storage, processing, biometrics, and security to deliver any time/any where/any thing connectivity.
- From a societal perspective the IoT/SC suite of standards represents tremendous possibilities to lower supply chain costs through improved visibility and to provide comfort in the knowledge of a product or assets' location and condition. At the same time the IoT/SC suite needs to incorporate adequate security and privacy features to prevent the compromise of the supply chain, its data, and any personally identifiable information capable of being collected through the application of this technology.
- From an environmental perspective the IoT/SC suite of standards simply enables the more efficient use of the products and assets. There are IoT technologies that are not so related to the supply chain, other than having the same base components that can monitor electrical usage water levels, pollution, and temperature. To the IoT/SC this simply means lower cost components due to the volume of usage across multiple IoT applications. One final environmental aspect of the IoT/SC is at the end of life of the product or asset. IoT/SC applications can aid in the proper and efficient recycling, reuse, and disposal of the product, package, or asset.

A.12 Global metrics

- The reader's attention is invited to review Clause A.1 of this annex regarding market relevance.

A.13 Technological benefit

- The IoT/SC suite is intended to standardize certain technical aspects of many existing standards. Greater utility is afforded a network of standards if they all utilize a common interface and common data structures. The communications of sensor measurements, location data, and unique identities are afforded greater utility with common standards. To enable devices to hand off connectivity from a personal area network to a local area network to a wide area network to a global network provides enhanced visibility. Competing identification schemes require a means to work together, both in the network and within various storage and processing media.

A.14 Economic benefit

- The Internet of Things must be as broad and as compatible as is the computer-based Internet of today. The impact and benefit to small and medium enterprises are well addressed in Clause A.8. The use of international communication standards removes barriers of international trade. This justification annex has attempted to quantify the associated metrics of a concept truly difficult to quantify. But quantifying the benefit of the Internet of Things is not dissimilar to quantifying the benefit of the Internet -- once in place we all know that it would be highly inconvenient to live without it. Clause A.10 has provided the economic benefits of each element within the IoT/SC suite.

A.15 Societal benefit(s)

- The combination of optically readable media, mobile phones, Internet connectivity, and the location of the mobile phones can access competitive pricing of items, as well as being able to provide instant identification of the remaining shelf life of a product prior to purchase.

- IoT connectivity with products and product packaging can also enable better product identification by disabled individuals through mobile phones.

- IoT connectivity with products and product packaging can also enable quicker identification of product contents that may have specific allergic reactions to a consumer.

- Products, packages, and assets that are outside certain environmental parameters may be continuously monitored as to their specific locations, alerting the owner when they go outside of those designated parameters.

A.16 Environmental benefit(s)

- From an environmental perspective the IoT/SC suite of standards simply enables the more efficient use of the products and assets. There are IoT technologies that are not so related to the supply chain, other than having the same base components that can monitor electrical usage water levels, pollution, and temperature. To the IoT/SC this simply means lower cost components due to the volume of usage across multiple IoT applications. One final environmental aspect of the IoT/SC is at the end of life of the product or asset. IoT/SC applications can aid in the proper and efficient recycling, reuse, and disposal of the product, package, or asset.

A.17 Intended uses

- The intended use of the IoT/SC suite is an application standard that brings together the various different standards addressing unique identification, communications, localization and tracking, processing, storage, sensors, actuators, data collection and communication devices, as well as security in a unified method of communicating business-to-business, business-to-consumer, and machine-to-machine data and observations, permitting any time/any where/any thing connectivity. This IoT/SC suite enables consumer goods manufacturers to communicate important information about a product to the consumer. This IoT/SC suite is available to business partners to specify the method of communicating data about products and assets. This IoT/SC suite is available to industry standards organizations to write compatible standards for its members. This IoT/SC suite is available to governmental standards bodies to write compatible standards for its constituency.

A.18 Traceable metrics

- ISO TC 122 will request its members to deliver a brief report at each plenary as to the level of IoT/SC activity in their respective countries.

A.19 Global relevance of the Internet of Things in the Supply Chain (IoT/SC)

- The IoT/SC suite effectively responds to regulatory and global market needs, as demonstrated by Clause A.6 and Footnotes 11 and 12.

- The IoT/SC suite effectively responds to scientific and technical developments in various countries, as demonstrated by Clause A.6.
- The IoT/SC suite does not distort the market, but combines existing disparate standards into a cohesive application standard.
- The IoT/SC suite has no adverse effects on fair competition, and in fact promotes competition with common standards.
- The IoT/SC suite does not stifle innovation and technological development, but builds on existing standards.
- The IoT/SC suite does not give preference to characteristics or requirements of specific countries or regions when different needs or interests exist in other countries or regions
- The IoT/SC suite is designed to be performance-based as opposed to design-prescriptive

A.20 Compliance with the Principles of developing standards supporting public policy initiatives

- The IoT/SC suite complies with the Principles for developing ISO and IEC Standards related to or supporting public policy initiatives as can be seen in Clause A.6.