SCIENCE EXHIBITION

***Project Report on Information Technology***

**Project Report on Information Technology :**

Information is the behavior initiating stimuli between sender and receiver. And the technology which is used to transport information from one to another is known as information technology.

Today technological advancements have affected our life style in every manner. Be it our life styles or anything else no part of our life is far from information technology.

***USES OF INFORMATION TECHNOLOGY :***

However it is used in many trades but some main are discussed below :

(i) Use in Wars.

(ii) Use in Defense or Forces.

(iii) Use in Education

(iv) Use in Entertainment.

***USE OF I.T. IN WAR***

The technology plays a vital role in modern war face. Jamming reader screens confounding their communication networks and other electronic country measure (ECM) techniques ensured, facile victory for the US & its allies. A project is being coordinated by Daimler Benz Aerospace, Defense and civil systems business unit in Germany is bound to set the standard for the foot rowdies of the 21st century out goes the automatic rifle and camouflage jacket and enter a palmtop computer strapped to his thigh sting global positioning system in shirt pocket, a helmet LCD that tells the soldier how many rounds of ammunition his light grencell firing sile has the latest baged instrument from his field commander.

***I.T. USE IN FORCES***

**ARMY :**

India armed forces the Indian army is developing high tech. PC based was games to train the officers to tackle real bottle-like solutions. The software is jointly developed by Indian army and defense research and development againstion.

**NAVY :**

The Indian Navy recently set up an information war face squadram. Recently the Indian navy organised a lecture ‘I.T.’ for a 21st century navy in Mumbai. According to the then chief of navel staff admiral Vishu Bhagwat the navy has accorded high priority to I.T. in its budget and acknowledge that the advent of such latest technologies many field to corresponding change in its command and contrast structure.

***I.T. USE IN EDUCATION - CHILDREN KNOWLEDGE***

Multimedia computers can set the children off on a voyage exploration, discovery and adventure. Be it is science, art, music or any other field. Learning through computers will awaken the joy of creative expression in children.

***I.T. IN ENTERTAINMENTS :***

Entertainment is necessary for human being man is not a machine. When he gets relaxed after continue work, One can improve his knowledge through Entertainment with the help of game is I.T.

Indigenous Technology Driving the Indian Defence Sector

Wednesday, September 23, 2015 by [Indiandefense News](https://plus.google.com/110604715679570898932)

***Zen Technologies UAV Simulator: Replicated Ground Control Station Zen Technologies Ltd., a maker of simulators and training software for the defence markets, rose near record highs after the company said the government's recent moves to lay more emphasis on sourcing defence equipment locally***

*by H J Kamath - Senior Vice President-Zen Technologies*

With India maturing as a regional power and aligning its focus on transforming into a global power, the defence sector is increasingly occupying a larger mindshare in the country’s long-term strategic plan. The ‘Make in India’ drive is a reflection of this pivot. Indigenous Technology will be the driving force for the Indian defence sector to truly mature and address the demands of the armed forces.

Wars are becoming technology intensive. The proxy and asymmetric warfare calls for a very high level of preparedness in terms of gathering Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR). India also has a long border with high rise Himalaya Mountains in the north and north-east, a combination of slush and desert in the west and north-west and deep jungles in the east and the rest of India is bound by large oceans which poses even higher order of threat, notwithstanding the claims by many adversaries on the ownership of deep oceans. The infiltration across the border and home grown terrorism also needs to be addressed.

To counter the perceived threats, Indian Defence Forces must be in possession of diverse range of weapons including various class of missiles, an excellent networked ISTAR system, a strong Air Force with flying assets well supported by Early warning systems, a strong army supported by ground based weaponry with a powerful logistics support and definitely a strong naval fleet to protect the littoral waters and carry out deep sea offensive operations. The last but not the least is to develop very strong training mechanisms to ensure all-time preparedness as well as to reduce the cost of training using live platforms.

The first step that needs to be taken by the Indian defence industry is to enhance its technological capability either through access to foreign military technology or indigenous development.To ensure that the indigenous technological base grows it should also be commercially viable. There is therefore a need to identify maximum number of R&D projects with a good mix of low, medium and high technologies that are not only in line with India’s strategic vision for defence but also have dual use potential.

There is no lack of R&D in the defence sector, however the knowledge has been left underutilized due to various reasons, which has compelled India to source technology from outside. India is one of the largest defence equipment importers, accounting for more than 14 per cent of global arms imports during 2009-13, Stockholm International Peace Research Institute (SIPRI). True indigenization starts with developing home-grown technology which is commercially viable and easily deployable.

The government has taken some crucial steps in the right direction by prioritizing indigenization of the defence industry and acquiring advanced technologies wherever possible. There is definitely a policy undercurrent which is attempting to steer the defence value chain towards indigenization.

One of the serious constraints faced by private sector in development of large systems is in the huge initial investments in terms of building technical infra structure, design tools and test facilities. This is where probably the collaboration with an experienced system-house from advanced countries could also come in handy. Notwithstanding this, the Defence users also look for NCNC (No Cost No Commitment) based procurement policy which would severely pinch the private sector especially the Medium Scale & Small Industries (MSSI). It is also required to set up a sizeable R&D force in the private industry to develop the requisite advanced technologies. The Ministry of Defence (MOD) has brought out the Technology Perspective and Capability Roadmap (TPCR) document based on the capabilities envisaged in Long Term Integrated Perspective Plan (LTIPP) 2012-27 of Indian armed Forces and approved by the Defence Acquisition Council in April 2012. Though the objective of the TPCR is to give private industry an opportunity to plan and build technologies and products required by Indian armed Forces based on LTIPP, it is yet to take finer shape as private industries now need to discuss with the armed forces on exact requirements in terms of capabilities, required quantity, and funding etc.

A few thoughts, which have been circulating in the corridors of the defence ministry to promote indigenization, are-

Buy Indigenously Designed and Developed: This category needs to be introduced and should be given the maximum preference. The heart of any weaponry and related system is the technology, the software, the algorithms that run the system. Where Indian companies develop technology that meets the requirements of the Indian forces, these products should be bought from that company at the same international prices (as per standard benchmarking done now) at which they would have been procured from foreign companies.

Buy Indian for Existing Requirements: Create a list of products for existing defence equipment. If there are any indigenously designed and developed products available to match the specs then place an order with the same firm. The minimum indigenous content for such procurements should be 75 percent.

There is visible enthusiasm amongst the private defence stakeholders and there is a need for the government to capitalize on the positive eco-system by reducing the red tape surrounding the Indian defence sector. Vision, mission, de-bureaucratization, indigenization and determination should be the key pillars of any future defence policy outlook. The government must ensure that the local defence industry is geared and incentivised enough to rise up to the expectations and make the government’s ‘Make in India’ initiative a success story.

To summarise, “Make and Made in India concept” is very good but it should result in designing and developing the product in India to the user requirements by the Indian Industry either by using the resources available in India or possibly with support from collaborative partner from abroad. This indigenous technology will be the key driver in ensuring that India reaches the status of a global power by 2025.

How has RFID technology helped the Australian Defence Force improve visibility while better tracking goods? Stephen Withers has the answers.

A ten-year, A$650m revamp of the Australian Department of Defence's logistic system known as Joint Project 2077 (JP2077) aims to replace more than 100 existing systems with a single military integrated logistic information system (MILIS).

Phase 2C of the project, delivered in March 2007, automates stores tracking through the use of radio frequency identification (RFID) technology tags and readers.

The motivation for improving traceability began in the late 1990s when it became apparent that the Australian Defence Force (ADF) was struggling to track equipment shipments both inside Australia and overseas.

During operations in East Timor in 1999, soldiers were reportedly unable to locate parts and supplies that had been shipped in to support them.

After the 2003 Gulf War, General Peter Cosgrove observed: "We've still got to move hard to bring automation into our logistics system and make sure that we can support troops at the end of a very long pipeline."

In 2004, the Department of Defence was unable to finalise its annual report due to an A$800m inventory discrepancy, including A$200m in general stores. It was said that the gap was due to lack of visibility rather than theft or other issues. JP2077 aims to deliver that automation and visibility.

MILIS

MILIS is based on a three-tier architecture. Tier one is a fixed, central capability within the national support base and supported with continuous communications. Tier two uses local servers deployed on ADF operations in areas with reliable if intermittent communications back to tier one. Tier three is highly mobile (e.g. laptop) and can be detached from tier one or tier two and deployed in areas with no communications for limited periods.

2C is the first phase of JP2077 to be completed. By the end of 2008, the core inventory system will be replaced; late 2009 will see the completion of the three-tier architecture; and the implementation of the remaining improvements will begin in 2010 (the procurement process has already begun). JP2077 may extend to 2017.

"During operations in East Timor in 1999, soldiers were reportedly unable to locate parts and supplies."

The RFID portion of JP2077 cost A$24m, and is being used to keep tabs on supplies being sent to Iraq. An Airbus A330 with a capacity of 18t flies weekly to the Middle East Area of Operations, and each cargo pallet or container carries an active RFID tag with the goal of improving the visibility of stores and assets across the operational supply chain in support of the warfighter.

Improving the visibility of items in the supply chain leads to a more accurate picture of the situation, and this in turn means supplies can be managed more accurately.

Improved accuracy means the commander in the field can have more trust in the supply chain, which can save lives.

RFID TAGS AND READERS

Tags are associated with stores items as they leave warehouses for the theatre, regardless of the mode of transport used. This is generally done at the pallet level, but multi-packs and critical items such as aircraft spare parts may be individually tagged.

Fixed RFID readers arranged in portal configurations read the tags as freight enters or leaves warehouses and distribution modes along the supply chain. Mobile readers are use at air terminals and certain other nodes in the chain.

The ADF selected tags and readers from Savi Technology to allow interoperability with allied forces. Savi's military off-the-shelf system has been widely adopted for use in military supply chains, according to a Department of Defence spokesperson.

The contract with Savi was signed in August 2003 and the RFID project was completed in April 2007. The rollout covered 31 sites in Australia plus one overseas (presumably in Iraq), along with 60 field-deployable kits. Just over half of the RFID project's budget went to Savi, according to Daryl Kendrick, managing director of Savi Technology Australia

At this stage, the interoperability is potential rather than actual. Australia, the US, Canada and the UK have a memorandum of understanding regarding RFID interoperability, but at this stage only the US and Australia have compatible and interoperable RFID systems.

"The RFID of JP2077 cost A$24m, and is being used to keep tabs on supplies being sent to Iraq."

In this context, interoperability means that a US RFID reader detecting an Australian tag would report its presence to the Australian system. Savi's other customers include NATO and Spain.

"Additional opportunities to achieve interoperability with nations in our immediate region are also being explored," a Defence spokesperson says.

ADF CARGO VISIBILITY SYSTEM

The project involved adding RFID tag data fields to the existing ADF cargo visibility system to enable data to be entered, and the installation of commercial auto-sync software so that data generated by the readers flows into the rest of the system. Savi and Department of Defence employees carried out the work, with additional support from contract staff.

Hendrick says Savi's RFID equipment and software was designed for easy integration, as RFID is only of value when linked to other systems. Phase 2C did take longer than expected, with the first RFID tagged supplies leaving for Iraq more than a year later than originally planned.

All major Australian military sites are now equipped with RFID readers, but the focus is on overseas supply chains. One exception is the national support base, which does not use RFID but relies instead on the cargo visibility system.

The tags and readers supplied by Savi are designed to cope with adverse conditions, and can operate for months on end in temperatures of 50°C.

The active RFID tags used in defence applications have a much greater read range – up to 100m – than the passive tags more commonly used in commercial applications.

The contract included hardware, software and services such as installation, training and documentation. "[The ADF] had a fully operating system," says Kendrick.

RFID SYSTEM SUPPORT

Issues affecting the use of the system in the field include ensuring the infrastructure is in place and sufficient bandwidth is available, a defence spokesperson says, along with providing initial and ongoing training for personnel and embedding robust processes and procedures. The ADF's integrated logistics support process takes care of these issues, the spokesperson added.

"All major Australian military sites are now equipped with RFID readers."

No specific problems arose during the rollout in Iraq, which was done in two phases over ten weeks. The Iraq deployment "successfully demonstrated the benefits of the system," the spokesperson said.

Savi is looking forward to an ongoing relationship with the Australian Department of Defence, including the supply of additional tags and field-deployable reader kits.

Kendrick also mentioned that the ADF could purchase other types of tag, such as devices capable of monitoring temperature for use with perishable goods such as food and pharmaceuticals.

Further developments could include the use of RFID to trace individual items rather than pallets or containers, but that would necessitate the use of cheaper tags for such a project to be financially viable.

Education :

Getting the right kind of information is a major challenge as is getting information to make sense. College students spend an average of 5-6 hours a week on the internet.Research shows that computers can significantly enhance performance in learning. Students exposed to the internet say they think the web has helped them improve the quality of their academic research and of their written work. One revolution in education is the advent of distance learning. This offers a variety of internet and video-based online courses.

Health and Medicine :

Computer technology is radically changing the tools of medicine. All medical information can now be digitized. Software is now able to computer the risk of a disease. Mental health researchers are using computers to screen troubled teenagers in need of psychotherapy. A patient paralyzed by a stroke has received an implant that allows communication between his brain and a computer; as a result, he can move a cursor across a screen by brainpower and convey simple messages.

Science :

Scientists have long been users of it. A new adventure among scientists is the idea of a “collaboratory”, an internet based collaborative laboratory, in which researchers all over the world can work easily together even at a distance. An example is space physics where space physicists are allowed to band together to measure the earth’s ionosphere from instruments on four parts of the world.

Business :

Business clearly see the interest as a way to enhance productivity and competitiveness. Some areas of business that are undergoing rapid changes are sales and marketing, retailing, banking, stock trading, etc. Sales representatives not only need to be better educated and more knowledgeable about their customer’s businesses, but also must be comfortable with computer technology. The internet has become a popular marketing tool. The world of cybercash has come to banking – not only smart cards but internet banking, electronic deposit, bill paying, online stock and bond trading, etc.

Recreation and Entertainment:

Our entertainment and pleasure-time have also been affected by computerization. For example:

i) In movies, computer generated graphics give freedom to designers so that special effects and even imaginary characters can play a part in making movies, videos, and commercials.

ii) In sports, computers compile statistics, sell tickets, create training programs and diets for athletes, and suggest game plan strategies based on the competitor’s past performance.

iii) In restaurants, almost every one has eaten food where the clerk enters an order by indicating choices on a rather unusual looking cash register; the device directly enters the actual data into a computer, and calculates the cost and then prints a receipt.

Government:

Various departments of the Government use computer for their planning, control and law enforcement activities. To name a few – Traffic, Tourism, Information & Broadcasting, Education, Aviation and many others.

Defence:

There are many uses computers in Defence such as:

1) Controlling UAV or unmanned air-crafts an example is Predator. If you have cable I would recommend watching the shows “Future Weapons" and “Modern Marvels". The show future weapon gives an entire hour to the predator.

2) They are also used on Intercontinental Ballistic Missiles (ICBMs) that uses GPS and Computers to help the missile get to the target.

3) Computers are used to track incoming missiles and help slew weapons systems onto the incoming target to destroy them.

4) Computers are used in helping the military find out where all their assets are (Situational Awareness) and in Communications/Battle Management Systems.

5) Computers are used in the logistic and ordering functions of getting equipments to and around the battlefield.

6) Computers are used in tanks and planes and ships to target enemy forces, help run the platform and more recently to help diagnose any problems with the platforms.

7) Computers help design and test new systems.

Sports:

In today's technologically growing society, computers are being used in nearly every activity.

Recording Information

Official statistics keepers and some scouts use computers to record statistics, take notes and chat online while attending and working at a sports event.

Analyzing Movements

The best athletes pay close attention to detail. Computers can slow recorded video and allow people to study their specific movements to try to improve their tendencies and repair poor habits.

Writers

Many sportswriters attend several sporting events a week, and they take their computers with them to write during the game or shortly after while their thoughts are fresh in their mind.

Scoreboard

While some scoreboards are manually updated, most professional sports venues have very modern scoreboards that are programmed to update statistics and information immediately after the information is entered into the computer.

Safety

Computers have aided in the design of safety equipment in sports such as football helmets to shoes to mouth guards

Potential of RFID in the Aerospace and Defense Market

Simon Holloway

EMEA Manufacturing Industry Solutions Architect

Microsoft EMEA

June 2006

Applies to:

Enterprise Architecture

Architecture Development

Summary: Describes the opportunities and business benefits of RFID in the Aerospace and Defense sector. It looks at various scenarios where RFID is and can be used to solve business problems. (29 printed pages)

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About the author

Executive Summary

RFID, short for Radio Frequency Identification, is a rapidly evolving technology that can dramatically improve operational efficiencies and customer service. RFID will fundamentally transform the way information about products, equipment, animals, and even people, is gathered and analyzed in real time, thus providing new business opportunities.

This white paper describes, for C-level executives and line-of-business managers, the opportunities and business benefits of RFID in the Aerospace and Defense sector. It looks at various scenarios where RFID is and can be used to solve business problems.

Highlights of this white paper include:

•The need for automation of the pedigrees, in order to solve the counterfeiting issue.

•The need for support for compliance with the US Department of Defense (DoD) Mandate and the commercial impacts of the Boeing–Airbus Initiative.

•The use of RFID technology to: ◦Provide visibility in the supply chain and production line.

◦Reduce risks in employee health and safety.

◦Verify plant maintenance.

To encourage widespread adoption of RFID technology, Microsoft is developing a layered RFID infrastructure and platform, using an open-building-block approach. The infrastructure described in this white paper enables independent hardware, software, and systems integration partners to offer a robust variety of cost-effective and standards-compliant RFID applications.

Current Issues in the Aerospace and Defense Marketplace

The Aerospace industry is heavily influenced by the economy, politics, government regulations, and consumer confidence. Significant emerging trends include the growth of the Asian and, in particular, Chinese markets; the continued Airbus/Boeing rivalry; outsourcing of Maintenance, Repair, and Overhaul (MRO); and the rise of low-cost regional carriers. The resulting business environment is expected to look as follows:

•Modest revenue growth—Rising military spending (mainly in the United States) has not been enough to offset the severe decline in the purchase of new commercial aircraft. This is expected to change in the next decade, with the launch of new aircrafts (A380, A350, and B787), the growth of low-cost airlines, and forecasts of doubled passenger demand by 2020.

•Competitive pressure to eliminate waste—Aerospace companies are creating corporate-wide lean enterprise programs to improve priority setting and magnify benefits.

•Better R&D performance—Industry investors and boards want to see greater return on investment (ROI) from their R&D investments. New product innovation is a cornerstone of this process.

•Increasing cooperation—Cooperation is expected to increase as companies collaborate on programs.

•Changing business practices—Business approaches such as Demand-Driven Supply Networks (DDSNs) address the needs of the newly outsourced manufacturing.

•Aftermarket sector—MRO will experience a shake-up.

Aerospace companies need to reduce the long product-development cycle times, while continuing to focus on delivering high-quality products. This means that there is a need to:

•Increase the number of design iterations and eliminate bad designs before moving on to detailed design and prototype production.

•Deliver new products to the market faster, better, and cheaper, through the use of real-time global collaboration.

•Vault engineering data (BOM), and capture design intent and the approval process.

Aerospace manufacturers need to increase their operations performance by improving cycle times, output, and overall effectiveness in the following areas: control systems, execution and tracking, quality, maintenance, and visibility. Visibility provides a layer above the manufacturing systems that gathers and aggregates data from many sources; contextualizes, analyzes, summarizes and formats information into dashboards and key performance indicators (KPIs) with real-time/historical data.

Aerospace Manufacturers need to reduce non-value-added work from their manufacturing processes, reduce inventory costs, eliminate stock outs, and provide a software backbone that allows manufacturers to sustain their Lean, Six Sigma, and ISO programs. Four critical areas need to be addressed:

•Value Stream Mapping & Analysis (VSM&AD)

•Project and Program Management (PPM)

•Collaborative Electronic Kanban (CEK)

•Demand-Driven Scheduling (DDS)

As Aerospace companies outsource more of their manufacturing, the need for real-time visibility, agility, and accuracy are of paramount importance in dealing with demand fluctuations, supply chain disruptions, and the expectations of well-informed customers. The value is getting the right decisions on short notice, in order to coordinate a complex range of activities among a multitude of partners. This has a direct influence on productivity, profitability, and the ability to stay competitive.

Airline CEOs and CFOs have an increasing focus and pressure on maintenance as a source of process improvement, cost savings, and, sometimes, even revenue generation. Aging fleets mean higher maintenance costs. Setting aside growing maintenance needs, facility and personnel reductions occur, and outsourcing is the fastest way to cut maintenance costs. This means that there is a need to:

•Increase supply chain velocity and customer satisfaction.

•Increase productivity and accuracy.

•Optimize inventory and lower operating costs.

The MRO market faces distinctive issues. This is being partly driven by the large percentage of low-cost carriers, increased outsourcing, and smaller average fleet sizes. Maintenance activities are also beginning to move east as airlines try to take advantage of lower labor rates/high technical skills that can be found in Eastern Europe; plus, there is a steady growth in the use of parts manufacturer approval (PMA) parts, and continued consolidation in the market triggered by overcapacity and declining margins. Europe accounts for almost one-third of the $36 billion global commercial and regional/business jet MRO market. Based on a 4.7 percent per annum growth rate, the world market for civil aircraft above 80 seats could be worth up to $1600 billion over the next 20 years (Source: MRO in Aerospace: Trends and Changes, Libbie Hammond).

Many manufacturing companies are adopting lean manufacturing principles, but the maintenance department is often not included in the process. Alongside the lean phenomenon, there is a move away from corrective maintenance and toward predictive maintenance strategies. The benefits of predictive maintenance are too numerous to mention, but they include minimizing costly downtime, minimizing catastrophic machinery failures, reducing maintenance costs, reducing spare parts inventories, increases machinery safety, and increasing the speed at which machinery can be operated, if desirable.

RFID in Aerospace and Defense

The application of RFID technology in the Aviation industry has many proven benefits, with the ultimate objective being continued air safety. RFID will:

•Improve airline configuration control, by increasing the accuracy of the known "as-delivered" configuration.

•Reduce ownership costs, by identifying rogue parts; this will also help minimize airline inventories.

•Provide reliable part traceability.

•Reduce internal processing and cycle time to solve service-related problems.

•Improve the accuracy of information exchanged between the airline industry and suppliers.

In addition, RFID technology offers a competitive advantage through support for:

•No line of sight requirement.

•Dynamic read/write capability.

•Simultaneous reading and identification of multiple tags tolerance in harsh environments.

With the need for strict safety, and therefore identity, the industry has been looking at ways to uniquely identity parts and assemblies.

Unique Identity: US DoD Initiative

Unique identity (UID) is the set of data for tangible assets that is globally unique and unambiguous, ensures data integrity and data quality throughout life, and supports multi-faceted business applications and users.

Click here for larger image

Figure 1. Different ways to display a UID (Click on the image for a larger picture)

The first thing the Standards Team accomplished was to define the UID in plain terms, giving it requirements that must hold up during all aspects of its life. The strategic purpose of UIDs is to:

•Integrate item data across government and industry asset management systems, thus resulting in: ◦Improved data quality and global interoperability.

◦Rationalization of systems and infrastructure.

•Improve item management and accountability.

•Improve asset visibility and lifecycle management, through lifecycle traceability.

•Enable more-accurate audit opinions on the property, plant, and equipment and operating materials and supplies portions of financial statements.

US DoD

Today's US military is a dynamic, rapidly moving force designed to be effective in an asynchronous battlespace. The enhanced mobility and speed of a combat force capable of performing in austere theaters with limited infrastructure creates a new class of challenges for military logisticians. The performance of logistics during the combat phase of Operation Iraqi Freedom created a compelling case for the change to fast, accurate, flexible, and mobile sustainable support. The challenges that face the US DoD in the Logistics sector are as follows:

•As of September 2001, almost half of DoD's $63.3 billion inventory exceeds war reserve or current operating requirements.

•DoD is unable to maintain adequate accountability over material shipped between contractors and DoD.

•The services all experience operations and maintenance problems because of a lack of key spare parts, specifically aviation spares.

•The services are not adequately monitoring, reporting, or getting reimbursement for defective spare parts received from contractors.

The DoD RFID vision is to implement knowledge-enabled logistics through fully automated visibility and management of assets in support of the warfighter. The DoD RFID goals are as follows:

•Increase warfighter/customer confidence in the reliability of the DoD supply chain.

•Improve visibility of information and assets throughout the DoD supply chain.

•Improve process efficiency of shipping, receiving, and inventory management.

•Reduce cycle time.

The end state for the DoD supply chain is to be a fully integrated adaptive entity that leverages enabling technologies and advanced management information systems in order to automate routine functions, and to achieve accurate and timely in-transit, in-storage, and in-repair asset visibility, with minimum human intervention. RFID is a foundational technology on the path to achieving this vision. DoD will ultimately operate a single, seamless, responsive visibility network, that is accessible across the backbone and usable by people and systems across the end-to-end supply chain. As a starting point, the DoD vision is for RFID to facilitate accurate, hands-free data capture in support of business processes in an integrated DoD supply chain enterprise as an integral part of a comprehensive suite of automatic identification technology (AIT) applications that DoD will leverage, where appropriate, in the supply chain to improve warfighter support (see Figure 2).

Click here for larger image

Figure 2. US Department of Defense supply chain (Source: DOD RFID: A Business Revolution, Maurice Stewart, RFID World, June 29, 2005) (Click on the image for a larger picture)

The primary actions performed by the physical nodes to move materiel through the logistics chain are the shipping/receiving/transportation processes. Figure 2 shows materiel movement that physically "touches" each node throughout the logistics path. But materiel can start, end, and move through different paths between logistics nodes:

•Manufacturers/suppliers to defense distribution center, for stock replenishment

•Defense distribution center to supply depots/theater distribution center, for stock replenishment outside the United States

•Defense distribution center to supply depots, for stock replenishment in the United States

•Supply department/theater distribution center to customer; direct vendor delivery

All these segments are impacted by RFID. Materiel movement includes moving back through the supply chain in the opposite direction (retrograde). RFID (active and passive) read and write capabilities will be required at the farthest point in the supply chain delivery system to support retrograde. The return/retrograde process is the same as the shipping process.

The standards that the DoD has evolved are:

•Active RFID for freight containers, air pallets based on SAVI readers, and tags working at 433 Mhz where suppliers will not be asked to tag.

•Passive RFID for cases and pallets (all items), item packaging (UID items) using standard EPCGlobal UHF readers, and tags where suppliers will be contractually obligated to apply tags at the case and pallet levels (see Figure 3).

The reasons given by the US DoD for the adoption of EPCGlobal standards for passive RFID were:

•It leverages the marketplace.

•Government and commercial sectors are on the same standard.

•It provides a consistent standard anywhere in the world where the Department operates.

•It provides a consistent standard with all suppliers.

•There is a drive for consistent standards and interoperability with allies.

Click here for larger image

Figure 3. Passive RFID Implementation Plan for DoD suppliers (Source: Enabling the Supply Chain with RFID Technology, Alan Estevez, RFID Live (Europe), April 11, 2005) (Click on the image for a larger picture)

At a conference in 2005, the US DoD talked about the implementation lessons they had learned form the use of RFID in their supply chain, as follows:

•Business process changes required to capture real benefit and business value:

•RFID improved timeliness and accuracy of receiving and shipping by 3 percent.

•User training improved performance.

•Technology is reliable:

•Read rates are around 96 percent.

•Equipment was ready to use just 33 days after the decision on the technology.

•Equipment was operational 100 percent of the time.

RFID and bar codes will coexist for several years, because both technologies have their merits. However, RFID brings several benefits over bar codes:

•Eliminates human error.

•Improves data accuracy/asset visibility.

•Performs in rugged, harsh environments.

•Allows for dynamic, multi-block read/write capability.

•Facilitates source data collection.

•Allows for simultaneous reading and identification of multiple tags.

Click here for larger image

Figure 4. Benefits of RFID across the US DoD supply chain (Source: Enabling the Supply Chain with RFID Technology, Alan Estevez, RFID Live (Europe), April 11, 2005) (Click on the image for a larger picture)

For further information on US DoD compliance, go to www.dodrfid.org.

UK Ministry of Defence: JAMES Project

As an example of the work of other defense ministries in the RFID space, the UK Ministry of Defence (MoD) has been looking at the Defence Engineering and Asset Management Capability Gap. They found:

•Poor or no visibility of equipment: ◦Location and ownership

◦Usage and future tasking

◦Configuration/modification state

◦Maintenance and repair loops

◦Spares & Consumables consumption

◦Defects or reasons for failure

•Inefficient/ineffective MoD engineering practices.

•Poor use of technology.

•Few effective partnerships with OEMs/industry.

The Ministry of Defence has derived a Defence Logistics Vision that states: "The Defence Logistics Vision envisages a highly effective, agile and networked logistic capability that underpins the operational commander's ability to execute his mission successfully. This capability will be derived from joint, integrated and interoperable support concepts, which have been tested and developed to provide the military commander with confidence in his ability to deliver effect at the desired tempo. Success will be built on adaptable systems and force elements combined with standardized logistic processes and procedures."

Based on the vision, a project was set up to produce a solution to these issues. The project is called Joint Asset Management & Engineering Solutions (JAMES), and it consists of:

•"Operational Innovation"—Business (Process & Policy) change (at least convergence to best practice).

•Convergence to common processes across equipment and environments, where possible.

•Where required, new management information systems (MISs) that absorb multiple existing systems.

•COTS software and open data standards. (If required, the Ministry of Defence will change processes to use the COTS software.)

•Incremental implementation with achievable benefits.

•Solutions that meet both MoD and industry requirements for all CLS arrangements.

Click here for larger image

Figure 5. MoD/industry interface: working with CLS (Source: Transforming Engineering and Asset Management in the UK MoD, The JAMES Programme, Lt. Col. Tony Bridges, Engineering & Asset Management Capability Change Team, Defence Logistics Organisation) (Click on the image for a larger picture)

The JAMES Programme for Land Force was rolled out during 2004 and 2005. The James Sea Programme has been accepted and is awaiting the completion of the rollout of their current system. The JAMES Air Project will converge tri-service helicopter E&AM processes and provide a single MIS. It is being implemented in three stages, running in parallel:

•Stage 1—Convergence to "best of breed," to meet urgent requirement for a single deployable MIS

•Stage 2—Convergence of Process & Policy

•Stage 3—A full JAMES with optimized Processes & Policies

For more information on the James Project, go to http://www.eamcct.dlo.mod.uk.

Boeing and Airbus Initiative

Boeing Co. and Airbus S.A.S. are using RFID technology to tag individual airplane parts, so that it is easier to track, maintain, and replace them. In 1999, Boeing began using RFID in aircraft tool management, and it equipped all its tools and toolboxes with RFID microchips that contained history, as well as shipping, routing, and customs information. Similarly, Airbus began RFID tagging its ground equipment and tools in 2000.

Boeing and Airbus are working together to promote the adoption of industry-standard solutions for RFID on commercial airplane parts. The two companies held industry forums in 2004. The invitations were sent to all the world's airlines, parts suppliers, regulatory agencies, and third-party maintenance repair and overhaul shops that do contracted maintenance on behalf of airlines. The goal was to educate, inform, and unite the industry around standard requirements for identifying parts.

Both companies:

•Recognized the necessity of permanent parts marking.

•Saw the need for an industry standard for automatic data capturing based around standardization of RFID in Air Transport Association (ATA) Spec2000.

•Are aware of the different requirements on permanent parts marking, depending on the part and its environment.

•Support the application of the appropriate marking technology (human-readable nameplate, bar code, or RFID) for each type of material.

Click here for larger image

Figure 6. Primary supply chain management factors (Source: RFID in Commercial Aviation, Jens Heitmann, RFID World, June 2005) (Click on the image for a larger picture)

The companies stated that they did not want to issue a mandate. Rather, they believe that RFID could provide major benefits for the entire industry. The manufacturers will get more accurate information about their demand for parts. They also will be able to reduce their parts inventory and cut the time that it takes to repair planes. Suppliers will also be able to reduce inventory, improve the efficiency of their manufacturing operations, and use the technology to verify to Boeing and Airbus that parts they get are genuine, thereby reducing the amount of unapproved parts that enter the supply chain.

Click here for larger image

Figure 7. The information flow of the future (Source: RFID in Commercial Aviation, Jens Heitmann, RFID World, June 2005) (Click on the image for a larger picture)

Standards are already in place. The Air Transport Association recently added an RFID standard to its Spec2000, a comprehensive set of e-business specifications, products, and services for the aviation parts industry. The standard calls for the use of IS0 15693 passive, read-write tags, which operate at 13.56 MHz. The RFID transponders will be integrated with existing bar codes, which will still be required.

Boeing has an RFID project under way in its 787 Dreamliner program, where time-controlled, life-limited parts and replaceable units have been identified with RFID "smart labels." These smart labels contain a microchip, an antenna, and store data, including part and serial numbers, manufacturer codes, country of origin, date of installation and maintenance, and inspection information. This information can be particularly useful in the maintenance of airplanes, because the service history of a part is stored on the RFID label as it goes thorough different stages of its life cycle.

Airbus has already begun using RFID on jigs and tools that it loans to airline maintenance centers. The tags are used to track the items as they are sent out to the centers and returned. Airbus will have 10,000 passive RFID chips on removable parts on the A380. Removable parts are replaceable units with short life cycles. For example, a wing of an airplane is a non-removable part with a 30-year life cycle, whereas a passenger seat has a five-year life cycle, and brakes are usually changed every 1,000 landings; both are considered removable parts.

Airbus and Boeing are also looking at having their suppliers tag transport containers and other shipping conveyances used in aviation industry supply chain. These will likely be tagged with passive UHF tags carrying Electronic Product Codes. Boeing may migrate to EPC tags on containers of parts quickly after EPCGlobal finalizes its specifications.

Boeing and Airbus unveiled last month a joint initiative with product-life-cycle management vendor Sopheon plc and Siemens Business Services, to provide an industry-wide Internet portal to selected reference sources for RFID implementation. The Siemens Compliance Direct Service is designed to promote standardization around RFID use. But the partnership between Sopheon, Airbus, and Boeing has even larger implications. It means that vendors like Sopheon are beginning to see a place for RFID in product-life-cycle management applications, which presents new possibilities of using RFID in product development, maintenance, and end-of-life recycling of aircraft and automotive parts.

University of Cambridge Auto-ID Aerospace ID Technologies Programme

The first in a series of sector-based research programs was launched in mid-2005 by the Cambridge Auto-ID Lab, focusing on the challenges and potential benefits presented by identification (ID) technologies. The programs will provide companies with the opportunity to support and steer key research into the adoption of appropriate ID technology in their area. It has been driven by the Boeing-Airbus Initiative.

Consultations with major aircraft manufacturers, their suppliers, and customers developed the initial themes for this research program. More themes will be added as sponsors join the program, bringing their own specific issues. Current themes are:

•Life cycle ID management—Managing the evolution of a component or piece of equipment through its life cycle.

•ID application matching—Guiding the selection of the best ID delivery solution to suit production processes and operating environment.

•Sensor integration—Evaluating methods for integrating ID data with other sensor information.

•Tag and data synchronization—Evaluating methods and strategies for the synchronization of ID data between components and networked resources.

•RFID-enhanced track and trace—Designing and evaluating methods for integrating ID data into existing and new track-and-trace strategies.

•Security

The program will be driven by the end users of the technology: the aircraft manufacturers and their suppliers, the operators, the owners, and the MROs.

Federal Aviation Authority and RFID

The challenge facing the Federal Aviation Authority (FAA) is to develop a policy to allow active and passive RFID technology on aircraft. Some of the concerns that are faced are due to emissions:

•Can multiple passive RFID devices be a source of interference to required aircraft systems (examining both fundamental and harmonic frequencies)?

•Can a strong, undesired, on-channel/off-channel signal "light up" all devices simultaneously?

•If so, what are the effects on aircraft systems?

This means that a ground EMI test may be required, in order to ensure that RFID equipment does not interfere with required aircraft avionics and electrical systems; a flight test may also be required.

The current status of the FAA policy is that it is in draft stage. The FAA is hoping to be close to final agreement on the Passive portion of the policy. The intent of the complete policy is to allow for installation of active and passive RFID devices on a variety of aircraft and equipment. The key points of the policy memo are as follows:

•RFID tags must be interrogated on the ground only.

•Active tags should go through a formal FAA certification process—e.g., supplemental type certification (STC) process.

•Fundamental frequency and harmonics of the RFID system must remain out of aviation assigned frequency bands.

•Active tags should receive full Failure Modes & Effects Analysis/ Hazard Analysis (FMEA/HA). This must be accomplished showing no risk to required aircraft systems.

•It is currently in the draft stage, but close to final agreement on the Passive portion.

Using RFID to Solve Current Business Issues

Identification technologies are changing rapidly. The advent of cheap RFID tags and other data storage techniques means that significant amounts of information can be stored on tags that are fixed to components or consumables. Major challenges now exist for the use of such ID technologies in both civil and military aerospace industries. Many industries that are dependent on aircraft can benefit from RFID:

•Airports

•Logistics

•Air freight

•Defense

•Catering

•Maintenance and Repair organizations

•Aerospace/suppliers

•Aerospace/OEM

Duncan McFarlane, Director of the Cambridge Auto ID Labs saw the current situation with RFID in the industry in the following terms:

•The industry had looked at passive/active RFID and on-board memory, with many functional development, ID programs, and PLM systems developed.

•The applications involved included asset-based, typically single-application, vendors working with single-company or private-cluster trial.

•Standards focus was on low-cost, passive solutions, off network data.

•Prices are stable at an active level, but high-class tags not receiving focus

•R&D: deployment research, but predominantly in other fields; the focus is on short life tags

(Source: Aerospace ID Technologies Programme, Duncan McFarlane, Cambridge Auto ID Labs, June 2005)

Product Authentication

Let us use an example to illustrate the problem of product authenticity. Airbus is responsible for every part fitted onto an aircraft. More to the point, it cannot afford to allow product that has not passed rigorous tests to be placed on an aircraft. Every product is certified for its quality. But one of the issues faced by Airbus is that in remote locations, such as some African countries, and even further afield, maintaining an aircraft becomes a monumental challenge, as does tracking that the parts that are fitted are only those that are certified. For one thing, there's the volume. About 1,000 new aircraft are manufactured each year, and another 25,000 are currently in service.

Airbus has estimated that around 3,500 parts on each aircraft lend themselves to RFID-based tracking—that equates to a tag requirement approaching 92 million, and an inventory that is beyond measure. It is not that engineers will purposely fit unsuitable parts, nor that the substitute products are of poor quality, but it can be hard to tell the difference, and because Airbus is responsible for the aircraft, it cannot afford to take any risks. At around $10 per tag—20 times the cost of more-common read-write tags—it adds up to too many trailing zeros to contemplate. But it is expensive for good reason. The tags used in the exercise, which has now passed its pilot phase, incorporate 20 times the capacity of normal tags, because of the service information requirements of the industry. The hope is that during the next two years this capacity will be increased to 6kb—60 times the normal capacity rating. This is because the tag will carry the history of the part and its usage through its entire life.

An alternative approach to storing the information on the tag would use a product information system. Here, the tag would hold only its unique identity. When an inspector came to look at the part, he or she would be equipped with a mobile reader that would interrogate the tag and pick up its unique identity; this would then use this as a key to call a Web transaction.

Production and Supply Chain Visibility

AMR Research estimates that there is between $16B and $30B of waste still in the US Aerospace and Defense supply chain—and approximately double this amount if considered globally (Source: Aerospace and Defence Industry Outlook, AMR Research).

Click here for larger image

Figure 8. The complete Aerospace supply chain (Click on the image for a larger picture)

Today's consumers are becoming increasingly demanding, and this is causing supply chains to have to adapt into "demand" chains. At the same time, there is increased complexity, with scope for new problems. Out of Stock is a major concern, with lack of visibility in the supply chain and increased pressure through lean manufacturing of less inventory/stock being held. Consumers—whether wholesalers, retailers, or healthcare providers—want to know where their goods are, because they are familiar with the experience they get from using Amazon, DHL, and other user-friendly environments. There are more participants in the supply chain, which is leading to more shrinkage, counterfeiting, copying, damage, and tampering. Most organizations see that these issues lie outside their boundaries with their suppliers or logistics companies. However, in practice, it has been found that these issues also lie inside organizational boundaries, particularly where plant-to-plant movements are concerned, or where a plant covers a large area. Therefore, production visibility is just as important to getting real data for management as visibility in the supply chain.

Modern warehouses have complex requirements. Fast product cycles, and the need to decrease inventory and increase the flow of goods through the supply chain means that warehouses cannot remain static. Virtual real-time data must match the supply to the demand. Furthermore, many light manufacturing operations, such as final assembly, customized packing, labeling, and engraving, have been moved from shop floors to warehouses and distribution centers (DCs).

Javed Sikander, Director of Industry Architecture at Microsoft, in his article "RFID Enabled Retail Supply Chain", states: "Businesses strive to make their supply chains more efficient by improving the information sharing throughout the supply chain. At each node in the supply chain, forecast and actual sales from the next node are collected, and planning may be done on what and how much to make, which drives what and how much to buy from the previous node. Today large demands are placed on manufacturers, distributors, and retailers along the chain to maximize efficiency, minimize cost, and provide the best value to the end-customer."

Click here for larger image

Figure 9. Supply chains are complex networks (Click on the image for a larger picture)

EPCGlobal's stance is that RFID provided the mechanism to provide the visibility necessary in today's complex supply chains. They envisage a sharing of information between companies (see Figure 10).

Click here for larger image

Figure 10. EPCGlobal network (Source: EPCGlobal) (Click on the image for a larger picture)

However, to handle this network effectively, you have to tackle the biggest issue, which is that during the supply chain, the same product maybe referred to by different product codes. The benefits of synchronized data are far-reaching, both from an internal and an external perspective. The sharing of data between trading partners is now one of the most important supply chain processes, because the integrity of the information is critical for the uninterrupted flow of goods. The term used to describe this phenomenon is global data synchronization (GDS). (For more information on GDS, please refer to the Microsoft white paper entitled "Global Data Synchronization.")

Maintenance, Repair, and Overhaul

Every day, airlines face the challenge of reducing operation and maintenance costs, and they are forced to look for better options. Advances in information technology (IT) have leveraged the development of enterprise resource planning (ERP), business process management (BPM), corporate process management (CPM), and computerized maintenance systems (CMMSs). Although these solutions have been designed for general purposes, some of their features can be applied to very specific organizations. Yet, though the number of solutions is increasing, there are currently only a few CMMSs that can be used specifically in the aviation industry.

CMMSs or maintenance, repair, and overhaul (MRO) systems for the aviation industry have evolved, and now include modules or applications that can provide reports containing summarized information, or that can communicate with other systems. Juan Francisco Segura, professor in the aviation industry at Universidad Iberoamericana in Mexico, identified that the need for a CMMS depended on the size of the fleet and the maintenance control requirements (Source: CMMS in the Aviation Industry, Juan Francisco Segura, Technical Evaluations.com, June 9, 2005). There are small airlines or air taxi fleets that control their operations using Microsoft Excel or Microsoft Access, and that use Microsoft Project for their forecasting or maintenance planning.

The requirements of the MRO events (Standard Maintenance Activities, Problem Resolution, and Directives) are generally the same:

•Identify the problem.

•Access the logbook.

•Locate the required parts.

•Retrieve the proper documents.

•Locate certified personnel.

•Locate the required tools.

•Complete the checklists/history log.

•Obtain a release certificate.

There is no doubt that one of the first signs that we need to have more information about regarding the maintenance processes is its cost and, as a related symptom, its variability. Why does the cost of maintenance service vary when it's applied to two aircraft of the same type? Also, given that interchangeable parts on aircrafts are replaced regularly, this represents a huge ongoing administrative task for manufacturers whose job it is to ensure airworthiness of aircraft in service. But with up to 70 percent of a mechanics time spent locating parts; the process is strewn with inefficiency. RFID technology—or, more precisely, the solutions that incorporate RFID—can greatly reduce these inefficiencies and ensure due diligence in terms of maintenance.

When an RFID tag is assigned to a component in order to record every stage of its repair work, one is able to track the process from its removal from the aircraft, to its subsequent reinstallation. By linking this tracking and tracing RFID-enabled system to an organization's CMMS/MRO, this system can have automated input of location information, to enable engineers to locate it and to know exactly what type of repair work was performed, and by whom.

RFID tags can also be assigned to materials (rotational and consumables) for their distribution to the stations, warehouses, or maintenance bases. Information regarding what components were sent or received, or are in transit, as well as their description, part number, serial number, and lot, is able to be maintained and recorded.

RFID tags can also be used on tools used for the disassembly process, so as to control who is using the tool, and since when he or she is using it. A particular use with gauging tools is that the system will associate the identity code on their tags to their description, manufacturer, and the date of their next gauging, in order to attract the necessary anticipated attention to the tool.

MRO shops, just like any factory, have good receipt and dispatch areas for inventory. The use of RFID to assist in managing a warehouse through tracking and tracing is well known from automotive and CPG industries.

All the situations that I have just described involve a great amount of documentation. Links between RFID and document management systems are in their infancy at the time of writing. Because the Aerospace and Defense industry also involves a large amount of regulatory documentation, I can see RFID being used to automatically trigger the production or updating of compliance document (see Figure 11).

Click here for larger image

Figure 11. RFID with document management and workflow management solutions for compliance (Source: Microsoft Corporation) (Click on the image for a larger picture)

However, we must understand that these information benefits are medium-term, because it takes time for the system (or the database) to collect all the records that are necessary in order to perform an analysis. The results of this analysis will allow us to know the maintenance times, the materials used, and so on, which will have to be interpreted by those employees who have enough knowledge and experience.

Analyzing the information should be helpful for:

•Maintenance planning.

•Material planning.

•Personnel planning.

•Financial planning.

Of course, the economic and man-hour benefits will vary for every case and system.

One benefit that has already been realized from a project at Airbus is the assurance of legitimate replacement parts use, in place of possibly inferior counterfeits. It is estimated that the use of counterfeits was costing Airbus over $8B in replacement costs.

Solutions

•Minimize unplanned maintenance.

•Manage revisions.

•Optimize inventory (out of stock).

•Rapid identification of the right parts in the optimal location.

•Mechanics can access document, task, and parts info through RFID HH devices, and locate and track approved spare parts.

•Identify and track tool location, usage history, and repair requirements.

Benefits

•Reduce overall maintenance costs.

•Minimize time out-of-service—this means more seats in the air.

•Improve customer and regulatory compliance.

•Improve quality and safety.

•Auto-completion of required maintenance forms.

•Full fleet health monitoring

•Improve worker productivity and reduce the human-error factor.

Click here for larger image

Figure 12. Automated MRO scenario (Source: SAP) (Click on the image for a larger picture)

In August 2005, Virgin announced that it had started trialing RFID to track parts at its Heathrow Airport warehouse. Gareth Lewis, IT services director at Virgin Group, stated that RFID was helping Virgin Atlantic keep its planes in the air longer. Every part of the airplane is tagged with RFID. A mobile reader is used to interrogate the tagged aircraft, in order to get a snapshot of all its component parts, thus providing a quick and efficient way of seeing what is in the plane. Virgin can call up all the details of the engine of a plane, and see whether they can keep it flying for another day or week before they have to service it. This boosts their efficiency (Source: RFID keeps Virgin planes in the air, Graeme Wearden, ZDNet UK, February 21, 2006).

RFID is very useful in monitoring the performance of the aircraft maintenance process, and in tracking components and operations in the technical warehouse.

This technology speeds up the data recording processes in a maintenance system, making them reliable and avoiding human error. It also brings savings in the number of man-hours used in paperwork. However, to install a wireless network and radio frequency antennas, the safety and integrity of the data must be ensured—this subject will become more important as the use of wireless networks spreads worldwide.

Plant Maintenance

Every manufacturing organization has to plan the maintenance of its plant resources. The maintenance of plant is a cost in terms of lost production time. The biggest issue is the amount of unplanned maintenance that can occur and its serious impact on tight production schedules. So how can RFID be used to help control and manage plant maintenance?

I will use the example of some work done in BP. BP tackled the plant maintenance issue at two levels. First, they have digitized operator rounds to improve efficiency and avoid unplanned maintenance. This supported the refining business's drive for a "highly reliable organization," by capturing the complex work rules into mobile applications. The processes followed are the same way each time, and were based on best practices. RFID is used to give a unique identification of the assets. As the operator checks the asset, an audit trail is automatically produced. The mobile applications are used to automatically generate work orders. The result is that, instead of the work being responding to breakdowns, it has been transformed into preventing them.

The second area in which BP has used RFID and wireless technology to reduce unplanned maintenance by using wireless technology to gather information is in a trial of mote technology in a refinery, to capture "secondary readings" and environmental data. Mote/sensors cost a fraction of the cost of wired sensors. Drawing on BP's experience in using this technology in one of their ships, the Loch Rannoch, they worked out how to bring motes and sensors together with intrinsically safe requirements into a fully packaged solution (Source: Sensory Networks in BP, Mike Haley, BP, Chief Technology Office, RFID Networking Forum, May 2005).

Where in the Aerospace and Defense industry are there similar circumstances about plant maintenance? Well, from the product side, we have already talked about the use of RFID to provide more-automated MRO. On the production line and in the testing beds, RFID could be used in the same way as BP has used it.

Hazardous Waste Disposal (RoHS and WEEE)

The European Commission worked for a number of years to understand the environmental impact of electrical and electronic waste, and concluded that the volume, the toxic content, and the relative ease of recovering and recycling important materials justified EU-wide action. The environment is defined as the "surrounding in which an organization operates, including air, water, land, natural resources, flora, fauna, humans and their interrelation (Source: ISO)."

The WEEE Directive and the RoHS directives passed into law throughout the EU in August 2004. In spite of the fact that this process is well advanced in the UK and elsewhere, many commentators have observed that there is a lack of understanding of the issues for EU businesses. There are also key details of the legislation that, even at this stage, are not fully finalized; however, the legislation effectively contains retrospective elements, so that many businesses are already substantially affected!

The practical upshot of this is that the equipment you are purchasing now is already adding to your problems under WEEE legislation, unless you have established asset management programs to ensure that every major asset is fully tracked and every minor asset is trapped at time of disposal. The cost of implementing such policies at the last minute will be prohibitive for most companies, and the recycling industry is predicting major problems as companies that have left it until too late find themselves on the front page, portrayed as environmental vandals. The scope of WEEE includes:

•Large and small household appliances.

•IT and telecommunications equipment.

•Consumer equipment.

•Lighting equipment.

•Electrical and electronic tools (with the exception of large-scale stationary industrial tools).

•Toys, and leisure and sports equipment.

•Medical devices (with the exception of implanted and infected products).

•Monitoring and control instruments.

•Automatic dispensers.

Under the directive, there is a dual focus: the producer pays the cost of recycling schemes (a producer is, for instance, a computer hardware or medical equipment manufacturer), and businesses are obliged to implement appropriate disposal policies or face penalties.

What is required is the creation of automatic systems that provide the user organizations with both the process of disposal and also the ability to prove compliance. Using RFID either when the goods are produced (to show when end of life occurs), or when goods are returned to the original supplier, can help with the tracking and tracing of the goods through this special version of reverse logistics. There is a major requirement to prove that a company has complied with procedures for the safe disposal of material. Therefore, RFID, in conjunction with workflow management and document management, provides a solution to this problem.

Health and Safety: Hazardous Conditions

All major organizations have a key corporate responsibility for the safety and health of their employees. For instance, in Rolls Royce's Statement of Accounts for 2005 it is stated: "Rolls-Royce recognizes that exceptional HS&E performance makes sound business sense. Our strategy is to protect our employees, contractors and the wider community; attract and retain a motivated workforce; maintain business continuity; avoid asset damage; and reduce overall costs. We also aim to have zero injuries and environmental incidents and to minimize the environmental impact of our operations (Source: Rolls Royce Statement of Accounts 2005, Rolls Royce website)."

Boeing is committed to providing a safe and healthful workplace for its employees, and to protecting the environment. Safety, health, and environmental improvements are an integral part of the company's efforts to become more efficient and productive.

Smiths Group is committed to ensuring that, as far as is practical, any detrimental effects of its activities, products, and services upon the environment are minimized. Smiths Group is committed to conducting all activities in a manner that achieves the highest practical standards of health and safety. They have been working hard to give EHS issues a high priority in the way they do business, and their performance derives from integrating EHS responsibilities into their day-to-day management activities.

How can a company ensure that an employee, when entering a hazardous operating zone, is authorized to enter that zone, and if not authorized, that he or she is accompanied by an authorized person? How can the employer ensure that the appropriate safety clothing is being worn by that employee?

Let us look at how one organization, BP, has tackled this problem. In 2005, there was a major incident at a BP refinery, in which a number of people were killed or seriously injured. BP set out to see how RFID could be used to improve safety and operations efficiency at chemical plants, refineries, and E&P facilities by locating workers (Source: Sensory Networks in BP, Mike Haley, BP, Chief Technology Office, RFID Networking Forum, May 2005). They wanted the capability to:

•Track workers who perform tasks in large, remote, or dangerous environments, and to quickly locate workers in an emergency.

•Provide warnings to workers in hazardous environments.

BP set up some trials to prove the concept, with the aim of refining it to prove operational feasibility by addressing intrinsically safe, form factor, size, and cost issues.

One of these trials involved the use of RFID tags to check that protective clothing and equipment was being used correctly. This check occurred as the employee was about to leave the control (safe) environment and enter the hazardous zone (see Figure 13). The RFID reader in the confined entry point checked for the following:

•Is the correct clothing being worn?

•Does the worker have the necessary safety equipment (hard hat, goggles, gloves, and so on)?

•Is the breathing apparatus detected?

•Is there a "permit to work"?

•Is there more than one person present, and who are they?

•Do those who are present have valid training certificates?

The trials also involved integration with local handhelds or backend systems.

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Figure 13. Safety equipment check (Source: Sensory Networks in BP, Mike Haley, BP, Chief Technology Office, RFID Networking Forum, May 2005)

Implementation Challenges of RFID

Implementing RFID involves a multitude of challenges. Multiple goals of an RFID deployment can lead to a complex project. It's better to focus on a few clear objectives. In an interview, Overby of Forrester Research said, "The fragmentation of the business case is forcing people to be more cautious and more analytical in how they approach the technology."

The other big challenge, Overby says, "continues to be cost," although she predicted that the adoption of the EPC Class 1, Gen 2 standards will put downward pressure on pricing. The Gen 2 standard makes the use of one secure tag possible worldwide, and it is expected to aid adoption of RFID across all industries. Other challenges include:

•Resistance to change—Many organizations today rely heavily on manual processes or barcode scanning to track goods. In any organization, moving from a familiar technology to a new technology poses a challenge, especially when it requires process change.

•Established barcoding infrastructure—In many manufacturing facilities and distribution centers, barcode systems have been used for many years. Since barcode systems are efficient and represent a substantial investment, it can be difficult to justify a change to RFID.

•No one size fits all—Today's RFID systems are customized for each deployment. "In fact, a successful implementation typically requires considerable experimentation to achieve adequate read rates and the delivery of actionable information to appropriate recipients," according to Alok Ahuja, Senior Product Manager of RFID at Microsoft.

•Environment—The physical properties of the products to be tagged, the antenna design, and other environmental factors can make it difficult for readers to work reliably. Liquids absorb radio frequency signals, and metal reflects them. As a result, performance can be affected by the item on which the tag is attached. External factors such as RF noise from nearby electric motors can also impact performance. However, as RFID technology matures and experience increases, tag and reader placement will become less an art and more of a science.

•Lack of integration—Lack of integration and isolated islands of automation can pose other problems for those considering RFID. Manufacturers' enterprise resource planning systems may not be linked in real time to shop floor systems. Currently, integration with back-end systems generally requires the creation of custom interfaces, which is often a time-consuming and expensive undertaking.

•Lack of skilled personnel—RFID-knowledgeable IT personnel are hard to find. Many organizations, regardless of size, will discover they have no qualified IT personnel in certain locations.

•Evolving standards—Managing multiple readers and related hardware can be a challenge, especially across multiple facilities. That's because global standards governing how RFID devices communicate with higher-level systems are evolving. At present, communication between hardware and software requires custom configuration. The situation is similar to that found in the early days of personal computing, when a specific vendor driver was required in order to link a printer to a PC and print documents. For those moving forward with RFID deployments, the fluid standards situation makes it imperative that system components provide an easy, inexpensive upgrade path.

•Data overload—An RFID reader will continuously scan each tag several times per second, for as long as the tag remains in its read range; therefore, the potential for data overload must also be considered. Some readers can be programmed to eliminate duplicate information, but data volume still can be overwhelming to the network. The reason is that RFID systems can capture information at more points than was practical with manual or barcode systems. Because few ERP systems were originally built to accept a high volume of low-level data, RFID system designers typically include some data filtering at the edge (device level).

•Data noise—The torrent of RFID data (called "noise") can overwhelm readers or cause ambiguity, especially in dense reader environments where scanning areas may overlap. Read rates are improving, but often they are not anywhere near 100 percent, due to unreadable, damaged, or missing tags. In addition, because reading is based on proximity, mistakes can happen. For example, a reader may read the tag on an item passing by on a forklift, rather than the tag on a stationary target. To prevent inaccurate data from being transmitted to enterprise applications, a successful RFID solution must be able to deal with erroneous or missing information.

•Multiplicity of vendors—No single vendor does it all, and therefore most RFID systems must be assembled from multiple sources. This can create integration obstacles if hardware and software don't work together.

•Resistance to information sharing—In systems that depend on information from various trading partners, information sharing issues must be resolved in order to achieve maximum benefit.

•Privacy issues—Finally, some privacy advocates claim that RFID will violate consumer privacy, and they have become vocal opponents of the technology. Although much of what they fear isn't currently practical (or, in some cases, technically feasible), these critics are being heard. Of particular concern is the use of RFID technology without advising the consumer of its presence and how it is being used. Vendors and users of RFID should be committed to using the technology responsibly, and to being vigilant about any perceived or actual misuse of personal data.

When you look through all the scenarios described in "Using RFID to Solve Current Business Issues," it becomes very apparent that the solutions involve more than just the use of tags and readers: they also involve support for integration with ERP solutions that run the company's businesses; collaboration with supply chain partners, both up and down the chain; and security/privacy support. This requirement, plus all the issues discussed earlier, means that the architecture in question must be both agile in nature, as well as heterogeneous in nature.

How Does the Microsoft RFID Architecture Address Business Needs?

To encourage widespread adoption of RFID technology, and to address the customer pains of managing multiple devices, smoothing the data, translating data into meaningful events and combating costly integrations, Microsoft is developing a layered RFID infrastructure, using an open-building-block approach. It relies on the Microsoft Windows Server system, related Microsoft applications platform products, and a growing number of integrated partner solutions. This approach provides a wealth of solutions for any size of organization or industry vertical, including manufacturing, pharmaceutical, or aerospace. Also, the combination of the Microsoft technology platform and partner solutions offers a multiplicity of applications, reflecting the broad potential of RFID.

The Microsoft RFID infrastructure enables compliance, automation, and business process transformation, while shielding users from changing standards/regulations. Toward this end, the company is developing core infrastructure components to support RFID applications and solutions. It is also RFID-enabling select systems within its family of Microsoft Dynamics enterprise applications products. The infrastructure provides a base set of tools for device abstraction and management, event processing, and applications integration.

Independent hardware, software, and systems integration partners play a key role in developing RFID applications based on the Microsoft .NET foundation technologies and Microsoft applications platform products such as BizTalk Server, which provides data integration services for supply chain operations. The Microsoft RFID technology can be embedded within third-party applications, or used on its own, to capture and interpret data from sensors, and to manage business events in an easy-to-deploy, user-friendly environment.

The Microsoft Layered Approach

The Microsoft RFID infrastructure platform consists of layers (see Figure 14). The architecture incorporates:

•Devices, such as readers and sensors.

•The Device Service Provider Interface (DSPI).

•Event processing engine.

•RFID application programming interfaces (APIs).

•Tools and adapters.

Click here for larger image

Figure 14. The Microsoft Real Time Enterprise Platform (Source: Microsoft Corporation, 2006) (Click on the image for a larger picture)

Because the layers are tightly integrated, applications and devices can seamlessly interconnect. Here's how the layers work together:

Devices Layer

The bottom Devices Layer consists of hardware such as RFID readers, printers, sensors, barcode scanners, 802.1X access points for wireless local area networks, handheld terminals, and Pocket PCs, which are provided by partners. Data transmissions from EPC readers and other devices from multiple vendors are processed through a Device Service Provider Interface that is included in the Microsoft RFID infrastructure. It provides a platform for independent software vendors and system integrators to install hardware in a plug-and-play fashion, resulting in a complete and seamless RFID solution.

Data Collection and Management Layer

To accommodate the potentially large variety and number of devices that could be resident in an RFID implementation, a Device Service Provider Interface provides a consistent way for devices from multiple hardware vendors to expose their device services to the Microsoft platform. DSPI provides a scalable, extensible infrastructure that allows customers to read data through any standards-based or non-standards-based sensor, regardless of format, thereby reducing dependency on a specific technology and protecting RFID investments long-term.

Event Processing Engine

This layer includes event and workflow management, messaging, and a business rules engine. The Event Processing Engine enables context-based or rules-based processing of RFID data, to provide information directly to line-of-business applications. Information also can be delivered to business processes that span applications, by means of Web services integration and orchestration products such as BizTalk Server. This layer provides the structure for integration across multiple facilities and partners. It also includes device management, in order to convert data into business process relevant information.

Click here for larger image

Figure 15. The Event Processing Engine (Source: Microsoft Corporation, 2006) (Click on the image for a larger picture)

Services Layer

The Services Layer includes product information resolution lookup, business process management, analytics/reports/notifications, and enterprise content solutions. The Microsoft RFID infrastructure makes it easy for partners to embed functionality directly into their application, or to build applications on the infrastructure. Open APIs and .NET-centric tools allow partners to quickly create specialized vertical solutions across a wide range of applications. The Services Layer also provides lookups to EPCIS servers where data about a tagged object resides.

Application Solutions Layer

This uppermost layer relies on services, data, and tools from the lower layers to implement application solutions that drive business processes for the end user. Microsoft relies on its partners to build out many of the solutions, which are divided between two classes of applications: real-time enterprise/point applications and batch-oriented enterprise applications. In addition, the RFID infrastructure also supports the Microsoft Dynamics family of enterprise applications.

Business Benefits

The Microsoft RFID infrastructure offers many potential business and technology benefits to those considering RFID systems today. In all cases, careful attention has been placed on open standards, and on overcoming the shortcomings of today's custom systems. Thus, the Microsoft RFID infrastructure is designed to lower total cost of ownership; simplify integration end-to-end, from the device level to back-end applications; convert data into actionable information; and provide a platform where Microsoft and its partners can build applications that take advantage of the volume and real-time nature of RFID data.

•Lower total cost of ownership—One of the most significant potential benefits is helping clients leverage existing investments in Microsoft Windows Server 2003, SQL Server, and BizTalk Server, as well as popular ERP and CRM systems, including Microsoft's own ERP systems, Microsoft Dynamics. These familiar tools also shorten the learning curve and make the applications easier to use.

•Simplified integration—The Microsoft RFID infrastructure allows for seamless integration of devices, with provisions for discovery, configuration, communication, and management. Essentially, it provides ways to integrate data from disparate sources from the physical layer, such as the shop floor, warehouse floor, and trading partners, and it governs how information flows through the stack and ends up in business solutions provided by partners or Microsoft Dynamics.

Because the DSPI basically makes hardware such as readers and printers plug-and-play, it helps system builders assemble the optimum solution and focus on larger project issues, without worrying whether a driver exists. Meanwhile, organizations deploying RFID are better positioned to take advantage of the hardware innovation and falling prices that DSPI promotes.

Firmware updates can be performed remotely across an enterprise, eliminating the need for physical intervention. Hardware health can also be monitored remotely. If a reader does not respond as expected, an administrator receives an alert so that corrective action can be taken.

•Converting data to actionable information—Above the Microsoft Devices Layer, an Event Processing Engine filters incoming noise while providing alerts and transformations. It reduces the data "noise" created by the volumes of redundant data it receives, and converts it into actionable information. This functionality is enhanced by the use of English-like vocabularies for rule creation, and a high degree of built-in configurability, thus making it easy for users to modify it. Similarly, performance and scalability are built-in, so that large volumes of irregular event streams can be handled and deployment can be distributed.

Built-in edge processing includes a highly flexible and configurable rules engine that addresses potential business problems. For example, if a shipment of 24 cases is expected, but only 20 tags are read when it arrives, the system can send an alert so that the operator can check the pallet. The operator can then confirm the presence or absence of the four unread cases, and transmit accurate receiving information to the enterprise application. Whether done at the edge or centrally, processing of data is transparent to the user.

Data management also requires context. Is the object arriving? Departing? This information can be provided by sensors on the Devices Layer that show the direction of movement. Or, it can be done by a combination of history and rules. For example, if the system has seen an object before, this would suggest it is departing rather than arriving. Adding the context of pending orders provides further confirmation of status.

•Application platform—Open APIs and a rich object model make it easier for partners or users to build new RFID-enabled applications, or to integrate RFID data with back-end applications. Tools include a centralized dashboard for device monitoring and configuration, and a Tag Data Simulator that permits RFID events to be simulated without input from actual devices. Tight integration with BizTalk Server and existing enterprise software makes it possible for partners and clients to convert RFID events to BizTalk Server messages, and to build closed-loop "RFID-aware" business processes.

For details of a sample of key Microsoft partners who are developing RFID-based solutions, go to www.microsoft.com/partners.

Conclusions

The business benefits of using RFID in the aerospace sector can be summarized as follows:

•Safety and security—Authenticating assets

•Improving track and trace, and reducing shrinkage

•Improving field maintenance and spares supply

•Managing and reducing airline parts inventories

•Establishing audit trails for each uniquely identified object

•Real-time component performance information

•Early malfunction detection

•Real-time aircraft/system usage

•Real-time subsystems monitoring

•Confirmation that the correct part is being used in the right place, according to specifications

•Collection of warranty-related data is possible

•Use of RFID as a quality management tool

The University of Cambridge Auto-ID Aerospace ID Technologies Programme, in a recent presentation, predicted the following post-2006 situation:

•Technology—Clearly specified, cost-effective, logical mix of ID technologies and low-class and high-class RFID

•Applications—Moving asset-based, multiple application, multi-company pilots, public demonstrators

•Standards—Tags, product data, network management and support (interfaces)

•Prices—Prices at pre-1999 ratios for all classes

•Vendors—Vendors focused on the industry as a whole

In the longer term, what will we see? A number of organizations have talked about RFID-enabled aircraft. This environment would provide the best conditions for cutting costs in the MRO scenario, as well as providing ePedigree authentication of parts (see Figure 16).

Click here for larger image

Figure 16. The RFID-enabled aircraft: pipe dream or real possibility? (Source: Aerospace ID Technologies Programme, Duncan McFarlane, Cambridge Auto ID Labs, June 2005) (Click on the image for a larger picture)

This scenario is based on there being a limited numbers of readers, but a large number of antennas that cover seats, maintenance spaces, crew areas, holds, and doors/hatches, supported by the use of intelligent software in order to provide not only automatic collection and correlation of data, but also business intelligence information.

The potential of RFID technology is enormous. Realizing the value however, requires a business-wide approach:

•Maximize the value through understanding the full breadth of the implications and opportunities presented by the technology.

•Minimize the risk of failure through appreciating the pitfalls involved in RFID technology selection, integration, and implementation in the end-to-end supply chain.

•Bring the right skills to bear, including: ◦Supply chain process reengineering.

◦RFID physical layer implementation.

◦Technology integration.

◦Enterprise systems.

◦Finance and tax planning.

◦Regulatory implications.

◦Program management.

◦Change management.

◦Corporate and social responsibility.

Awareness of RFID technology and the benefits that it delivers is increasing across the industry globally. By playing a key role in developing the infrastructure required for RFID, Microsoft is contributing to the momentum of mass deployment.

The fully-integrated Microsoft architecture for RFID embraces a vision for increased operational efficiency and reduced costs. It enables the exchange of RFID-related data, in near-real time, across disparate systems and corporate boundaries. It also supports standards for global data synchronization and interoperability with EPC, which is a prerequisite for global adoption of RFID.

Microsoft is playing a leadership role in RFID, data alignment, and traceability, through participation in a number of industry initiatives and involvement in the development of standards for RFID. Our RFID Council is also contributing to the development of the technology by helping organizations track items more effectively.

Through a network of world-class partners, including ISVs, hardware vendors, and systems integrators, Microsoft is delivering RFID solutions that add value to businesses and enable fast returns on technology investments.

The key to realizing the benefits of RFID technology is treating it as a true enabler of business reengineering—a step change in improving both integrity and efficiency.

Appendix A: More Information About the Microsoft RFID Solution

For more information about the Microsoft RFID solution, please call:

•US: +1 425-707-4637, or send an e-mail message to Alok.Ahuja@microsoft.com.

•EMEA: +44 118 909 3521, or send an e-mail message to simon.holloway@microsoft.com.

Also, more information about the Microsoft RFID solution is available on the Web, at msdn.microsoft.com/canada/rfid.

The following organizations provided invaluable research and insights for this white paper, and the author would like to thank them for their contributions. Industry officials interested in obtaining more information about the research cited in this report should contact the organizations at these websites.

Table 1. Research firms and Microsoft solution partners mentioned in this white paper

Organization

Website

US Department of Defence http://www.dodrfid.org

UK Ministry of Defence (JAMES Projects) http://www.eamcct.dlo.mod.uk

Federal Aviation Authority http://www.faa.gov

EPCGlobal http://www.epcglobalinc.org

Airbus http://www.airbus.com

Boeing http://www.boeing.com

University of Cambridge Auto-ID Aerospace ID Technologies Programme http://www.aero-id.org

Military Robotics: Robots in the Military

Table of Contents:

1.Military Robotics: Robots in the Military

2.UGVs

3.UAVs

4.UUVs

5.Predator

6.Future

The utilization of Robotics in military is well shown by US army. Osama and other terrorists were tracked by these military robots. They are robust, they are obedient, they are daring, they don’t have fear of death, and most important they have proved themselves in Iraq and Afghanistan. Now, terrorists are terrified by drone attacks. The utilization of robotics technology in military led to a new field in robotics i.e. Military Robotics.

Military Robotics, Military Robots, Robots in Military

Military robotics isn’t about creating an army of humanoids but utilization of robotics technology for fighting terror and defending the nation. Thus, military robots need not be humanoids or they not necessarily need to carry weapons, they are just those robots that can help the armed forces. The opportunities offered by these technologies are boundless. Apart from army research centers there are many private firms also which provide military robots for defense forces like Foster Miller,21st Century Robotics, EOD Performance, Northrop Grumman, General Atomics etc. They have created many job opportunities and are developing this sector. It is expected that its market will extend up to $9.8 billion by 2016.

History

The vision of robot army isn’t a present day concept. The introduction of military robots is dated back from 1898 by the introduction of radio boats by Nicola Tesla. It was visualized by many visionaries in the last century. They were used by Germans and Russians in Second World War. Russians used Teletanks and Goliath were used by Germans. The Teletanks were equipped with DT machine guns, flamethrowers and smoke container to provide a smokescreen. The use of Goliath which is a mobile landmine in World War II by the Third Reich's forces also marked as a turning point in the history of military robots. And today the development in this technology is well demonstrated by military robots in Afghanistan and Iraq. At present the most commonly used military robot is the unmanned aerial vehicle IAI Pioneer and RQ-1 Predator.

One threatening question must be arising, as in every science fiction movie, it is shown that robots have gone crazy and started hunting us, will they go crazy in real world also? Actually, at present it is almost impossible. The developers have very well taken care of this aspect. Most of the military robots are remotely controlled by a human. And if someone has gone crazy then there is a reset button which clear there memory and they again come back to normal state. But with the development in artificial intelligence and military robots, there should be greater attention to implicate their ability to make autonomous decision.

Operations

Military OperationsToday military robots use very sophisticated and advance technology for operations. They use different technologies for reconnaissance, guidance and weaponry. They basically use GPS, Fiber Optic Tethers, LIDARs for guidance. GPS is based on satellite connections and is even used in mobile phones. The fiber optics is a hi-tech and hi-speed communication system especially used by defense. LIDARs are based on laser communication and nowadays used by traffic police to detect over speeding vehicles. For reconnaissance they use other technologies like cameras, electronic RF sensor, RADAR, etc. The robots are mainly used for reconnaissance purposes but they can also carry lethal and non-lethal weapons like AGM-114 Hellfire missiles, M249 saw machine guns, ammo can, bomb diffusal kits, grenades, etc.

VARIETIES

Military robots come in different shapes and sizes as per the task they are designated for. In the development of military robots, we can consider US Mechatronics which has created or developed a working automated sentry gun and is presently developing it further for commercial as well as military use. As far as military robots development is concerned, we cannot forget MIDARS which is a four-wheeled military robot. This robot is outfitted with many cameras, radar, and a firearm that performs arbitrary patrols around a military base automatically. Their size can vary from a small bot TALON and large UAV MQ-1 Predator. Their design is also task specific like, predator is for surveillance and attack from air so it is more like an airplane while TALON is for attack from ground so it is more like an armoured tank. There are three popular classes of military robots i.e. UGVs, UUVs and UAVs.UGVs

# Military Use Of Robots Increases

Date:

August 5, 2008

Source:

Washington University in St. Louis

Summary:

Robots in the military are no longer the stuff of science fiction. They have left the movie screen and entered the battlefield. Researchers report that the military goal is to have approximately 30% of the army be robotic forces by somewhere around 2020.

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FULL STORY

Robots are increasingly taking over more soldier duties in Iraq and Afghanistan, with predictions that as much as 30 percent of the U.S. Army will be robotic by 2020. WUSTL computer scientists who work on robots say the machines still need the human touch.

Credit: Image courtesy of Washington University in St. Louis

Robots are increasingly taking over more soldier duties in Iraq and Afghanistan, with predictions that as much as 30 percent of the U.S. Army will be robotic by 2020. WUSTL computer scientists who work on robots say the machines still need the human touch.

Credit: Image courtesy of Washington University in St. Louis

Close

War casualties are typically kept behind tightly closed doors, but one company keeps the mangled pieces of its first casualty on display. This is no ordinary soldier, though — it is Packbot from the iRobot Corporation.

Robots in the military are no longer the stuff of science fiction. They have left the movie screen and entered the battlefield. Washington University in St. Louis's Doug Few and Bill Smart are on the cutting edge of this new wave of technology. Few and Smart report that the military goal is to have approximately 30% of the Army comprised of robotic forces by approximately 2020. Of course, they aren't envisioning robotic soldiers from movies like "Star Wars" and "I, Robot."

"When the military says 'robot' they mean everything from self-driving trucks up to what you would conventionally think of as a robot. You would more accurately call them autonomous systems rather than robots," says Smart assistant professor of computer science and engineering.

All of the Army's robotic force is teleoperated, meaning there is someone operating the robot from a remote location, perhaps often with a joystick and a computer screen. While this may seem like a caveat in plans to add robots to the military, it is actually very important to keep humans involved in the robotic operations.

"It's a chain of command thing. You don't want to give autonomy to a weapons delivery system. You want to have a human hit the button," says Smart. "You don't want the robot to make the wrong decision. You want to have a human to make all of the important decisions."

**Not like the Terminator**

While movies display robots as intelligent beings, Smart and Few aren't necessarily looking for intelligent decision-making in their robots. Instead, they are working to develop an improved, "intelligent" functioning of the robot.

"It's oftentimes like the difference between the adverb and noun. You can act intelligently or you can be intelligent. I'm much more interested in the adverb for my robots," says Few.

Few, who is Smart's Ph.D. student, is also interested in the delicate relationship between robot and human. He is working to develop a system in which the robot can carry out a task while keeping a human in the loop and with the ability to create new goals for the robot. Few says that there are many issues that may require "a graceful intervention" by humans and these need to be thought of from the ground up.

**Meet George Jetson**

"When I envision the future of robots, I always think of the Jetsons," says Few. "George Jetson never sat down at a computer to task Rosie to clean the house. Somehow, they had this local exchange of information. So what we've been working on is how we can use the local environment rather than a computer as a tasking medium to the robot."

To work toward this goal, Few has incorporated what many would simply consider a toy into robotic programming. Using a Wii controller, Few capitalizes on natural human movements to communicate with the robot. Using something as simple and as common as this video game controller also has added benefits in a military setting. Rather than carting around a heavy laptop and being forced to focus on a joystick and screen, soldiers in battle can stay alert and engaged in their surroundings while performing operations with the robot.

"We forget that when we're controlling robots in the lab it's really pretty safe and no one's trying to kill us," says Smart. "But if you are in a war zone and you're hunched over a laptop, that's not a good place to be. You want to be able to use your eyes in one place and use your hand to control the robot without tying up all of your attention."

Robots are already finding a place among deployed troops. There are unmanned aerial vehicles and ground robots for explosives detection. Robotics advancements do, however, raise new ethical questions, such as where to place the blame if a robot kills someone. Nevertheless, as the technology progresses, more robots are being sent into battle first. The mangled Packbot on display at iRobot is just one such example of a fortunate casualty.

"When I stood there and looked at that Packbot, I realized that if that robot hadn't been there, it would have been some kid," reflects Few.

**Story Source:**

The above post is reprinted from [materials](http://news-info.wustl.edu/tips/page/normal/12080.html) provided by [**Washington University in St. Louis**](http://www.wustl.edu/). Note: Materials may be edited for content and length.

A number of robots in development for the military are being given increasing amounts of autonomy. The question is now how they will be used.

By Sharon Weinberger

18 November 2014

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Think of advanced robotics, and it is easy to let your mind wander to the sentient beings depicted in Blade Runner, or the soulless, autonomous assassins in the Terminator franchise.

But, despite widespread press about armed drones hunting down terrorists and insurgents in Afghanistan and Pakistan and the increasing use of ground robots to fight roadside bombs, the truth is that most military robots are still pretty dumb. In fact, almost all unmanned systems involve humans in almost every aspect of their operations—it’s just that instead of sitting in a cockpit or behind the wheel of a vehicle, humans are operating the systems from a joystick or computer often at a remote base far from the action.

Now that is slowly beginning to change.

Next week, one of the Pentagon’s most commonly used robots will finally make baby steps toward greater autonomy. The PackBot, a tracked robot used by US troops to help clear bombs in Afghanistan, will get a number of upgrades that will allows it to operate autonomously in some situations, according to Tim Trainer, a vice president for product management at iRobot, which makes the pint-sized bots.

Still, the autonomous capabilities will actually be fairly limited. In cases where the PackBot loses contact with its human operator, it will retrace its steps back to where it was when it last had communications. While seemingly simple, this small step toward autonomy is a critical improvement: in the past, if the robot lost communications while on its way to defuse a bomb, an explosive ordnance disposal technician would have go and retrieve it, potentially exposing the person to risk.

The upgrade includes other basic elements of autonomy, such as the ability to right itself if it falls over—a big problem in Afghanistan’s rough terrain—and the ability to navigate between specific waypoints, using satellite navigation and overlaid imagery, without constant communications with an operator. “Those are first steps to autonomy,” says Trainer.

The idea is to take these slow steps toward autonomous robot operations so that the military’s confidence grows, explains Trainer. Eventually, he says, the PackBot will be able to perform more complex tasks without human intervention, such as clearing an entire building of potential threats.

While these improvements are a far cry from the notion of robotic foot soldiers, it represents the reality of where military technology is today. “I don’t think you’ll see autonomy as the breakthrough leap,” says Trainer. “It’s not like we’ll have the one autonomous solution.”

‘Skinless Terminator’

Indeed, the Pentagon’s progress toward fielding autonomous robotic systems has been agonizingly slow, concluded a recently released report by the Defense Science Board, a panel of defence experts that advises senior Pentagon leaders. They placed a large part of the blame for a lack of autonomous robots on misperceptions about what autonomy means.

“Unfortunately, the word ‘autonomy’ often conjures images in the press and the minds of some military leaders of computers making independent decisions and taking uncontrolled action,” the report notes. And even though the reality is often much more prosaic—such as having a robot flip over on its own—those concerns have still served to limit the military’s willingness to embrace autonomy.

“It should be made clear,” the panel says, “that all autonomous systems are supervised by human operators at some level, and autonomous systems’ software embodies the designed limits on the actions and decisions delegated to the computer.”

Of course, statements like this do not reassure everyone. Some forward-looking robotic expert have already called for more debate about the subject of autonomy. They point towards developments such as the SGR-A1, a gun-toting sentry robot, developed five years ago by Samsung Techwin Co for the South Korean government as a way to patrol the border between North and South Korea. The fixed robot uses pattern recognition software to spot humans and a machine gun if needed. Although the robot is designed to operate with human intervention, it is its autonomous mode that has caught ethicists’ attention as a possible precursor of future developments.

While some defense officials may downplay concerns about autonomy, Jonathan Moreno, a professor of medical ethics and health policy at the University of Pennsylvania, is urging policymakers to think now about the implications of unmanned systems, which is already having profound implications. “From a geostrategic standpoint, it widens the scope of the battlefield - now it extends from the United States to Afghanistan and Pakistan,” he says. “That is really new. “

But for the majority of those working in the field, “killer robots” are not on their radar. Instead, they say, military robots are likely to be used initially for jobs that are dangerous, but not involved in actually fighting enemy forces.

Already under development, for example, is a military humanoid robot that will fight fires on ships. The innocuously named Shipboard Autonomous Firefighting Robot, or Saffir, actually looks suspiciously much like a skinless version of the Terminator, though its mission is much more peaceful.

Saffir, which is being developed by university researchers in cooperation with US navy scientists, is designed to fight fires on naval ships. But even these firefighting robots are being developed specifically to work with human counterparts, so a major focus of the work is on getting the robots to respond to human gestures and speech.

Human touch

Another robot being designed to help human soldiers is the Bear (Battlefield Extraction-Assist Robot), a humanoid robot with tracked legs. The Bear, built by Vecna Technologies, was initially funded by the US Army and designed to scoop up injured soldiers from the battlefield, transporting them to a safe area where they could receive medical assistance. The idea was that in the middle of a firefight it would be better to send in a robot to rescue a person, rather than another soldier who might get injured.

But Vecna Technologies's chief technology officer, Daniel Theobald says that the company now is focusing on other missions for its robotics work. “We quickly realized if we could build a robot that could rescue a wounded soldier, it would also be capable of a lot of other high value activities,” he says.

One of the missions the company has focused in on is logistics, or the idea of having robots move things from one place to another, or loading and unloading supplies. While not as glamorous perhaps as battlefield rescues, this sort of work is still critical to keeping human soldiers out of danger.

“A lot of time when soldiers get wounded, it’s because they are doing some other activity, and couldn’t keep their hands on their weapons,” says Theobald.

Moving supplies is also a mission envisaged for Boston Dynamic’s Big Dog, which has captured public attention for its eerily mammal-like movements. But like other robotic efforts, Big Dog’s road to autonomy is slow - its designers would like it to be able to sense objects or barriers on its own, for example, but it would ultimately be supervised by a human.

Indeed, in Afghanistan, for example, just moving things around has become a dangerous job, because it exposes troops on the ground to roadside bombs, which continues to be the leading cause of battlefield deaths there. Put robots in the place of the humans, and, at least in theory, lives would be saved.

Theobald says that when it comes to the battlefield, the first autonomous robots are likely going to be essentially deliverymen. “Let the soldiers do the fighting,” he says. “Moving things around, that’s something that the robots can do.”

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Sentry duty (Credit: Copyright: Getty Images)

Sentry duty

The SGR-A1, developed for the North/South Korea border, can in theory fire a gun without human intervention, raising concerns about autonomous robots. (Copyright: Getty Images)

Walking reality (Credit: Copyright: Boston Dynamics)

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Walking reality

The reality is that most robots still depend on humans and most are being developed for more more mundane jobs, such as carrying supplies for troops. (Copyright: Boston Dynamics)

Pick-me-up (Credit: Copyright: US Army)

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Pick-me-up

Robots like the Bear could also be used for dangerous tasks such as retrieving injured soldiers from the battlefield and transporting them to safety. (Copyright: US Army)

Fire crew (Credit: Copyright: RoMeLa)

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Fire crew

Others, such as the advanced humanoid robot Saffir, have been built as a possible way to tackle fires onboard ships run by the US Navy. (Copyright: RoMeLa)

Bomb squad (Credit: Copyright: iRobot)

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Bomb squad

Currently, one of the main tasks for military robots like iRobots SUGV is looking for and disposing of explosive devices. (Copyright: iRobot)