Readiness Assessment Report for A&P Supermarkets

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Automated Checkout System

Using Radio Frequency ID Tags

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1. Executive Summary

A&P sees a future of automated checkout system where goods will be scanned in a cart and customers have their credit card or checking account automatically billed for their purchase. If the company has RFID tags embedded on every item at their supermarkets, the customers will bag and walk out without going through a long checkout lines.

Technology Readiness Levels (TRLs) is a method to assess the maturity level of the RFID technology. Effective use of the TRLs can reduce the risk for the company when investing in the automated checkout system.

The readiness assessment results have indicated that the levels 1, 2, 3 and 4 have been reached the maturity of the RFID technology. For the levels 5 and 6, the technology is still in yellow state because the current tags do not transmit well on certain products such as liquids or metals. This limits the overall benefit of RFID until the problem can be resolved. In addition, the automated checkout system prototype has neither been demonstrated nor completely tested in level 7 and 8. Finally, the level 9 is not achieved because the system has not gone though successful mission operations.

The maturity of the RFID technology is achieved at level 6 which is not considered to be acceptable risk for us to implement the automated checkout systems at our supermarkets. Currently, researchers keep on looking for ways to improve the quality of the RFID tags. Furthermore, research facility is building up prototypes to test and demonstrate in a relevant environment.

2. Introduction

Imagine near the future, going to grocery store and filling your cart with the goods that you need, and simply walking out of the store without stopping at a checkout counter. This situation is quickly becoming a reality, and waiting in the checkout line will soon become a thing of the past. The technology that enables this will be a Radio Frequency Identification (RFID) that is becoming more and more present in our daily lives. Soon, every item on every shelf will be fitted with the RFID tags, and each item in your bag is scanned as it leaves passing under the RFID reader and the credit card or checking account of your choice will be automatically billed for your purchase. The company's goal is to make customers more convenient and comfortable at their stores. Therefore, A&P considers using RFID tags to identify and checkout items at their supermarkets without going through traditional checkout lanes. The following design is an attractive set of checkout aisles that A&P is targeted at their self service customers.

Fig 1 - Using RFID techniques to scan a cart or basket full of groceries in a few seconds; its features include: a scanner to detect and identify the tag attached to each item; electronic payment with smart cards or magnetic swipe cards.

The automated checkout system can be regarded as a business process that will improve radically the sale product chain in many aspects. Using the automated checkout systems will reduce labors costs for the company, and also shorten checkout times for the customers. Thus, A&P would like to conduct a readiness assessment using TRL method to measure the maturity level of the automated checkout system's hardware and software based on answering a series of related RFID technology questions.

3. Background

3.1. A&P Company

The Great Atlantic & Pacific Tea Company Inc (A&P) has operated A&P supermarkets since 1880. Over the years, the company has provided needs with freshness, quality, convenient, value places for American families to shop. With corporate headquarters in Montvale, N.J., A&P has 427 stores in the United States under 8 retail banners, which include conventional supermarkets, food and drug combination stores, and discount food stores. Today, Christian W.E Haub and Eric Claus, who are an executive Chairman and Chief Executive Officer, run the company. There are 42,872 are currently employs at the company and its annualized sales volume is approximately $11 billion.

As the company grows, it provides more convenient, flexible services to customers at our checkout lines. Five years ago, the automated checkout lanes were installed at supermarkets using bar code technology. The system provides all the functionality that a regular checkout lane offers, including accepting frequent shopper card, scan articles with UPC, checkout of non-UPC items like produce, vendor or store coupons, handle payment in cash, credit card, debit card, check, and food stamps.

Below is an image that shows how an automated checkout lane looks like at A&P supermarkets.

Fig 2 – A touch screen displays along with verbal instruction walk customers through the checkout process. Shoppers scan products, or weight their fruits and vegetables; then bag their own groceries. They have an option to pay with cash or with credit card.

However, using barcodes are cheap but they cannot be reprogrammed and they have low storage capacity. Today, using RFID can enable automated checkout to be used. Therefore, the company is interested in operating automated checkout systems at their retail supermarkets throughout the United States.

3.2. Technology Readiness Levels (TRLs)

Previous works from Department of Defense has shown that when programs proceed in production, they experience delays, rework, inaccurate, cost increase that could force the Department to fail the program. Therefore, NASA initially proposed the TRL method for assessing the maturity of a technology in 1995. The technology is assigned a readiness level from 1 through 9, indicating an increasing level of maturity of the technology. Later Department of Defense (DOD) adopted it in June 2001. The following definitions are giving by DOD (NASA variations show in parentheses, as applicable)

TRL 1	Basic principles observed and reported
TRL 2	Technology concept and/or application formulated
TRL 3	Analytical and experimental critical function and/or characteristic proof of concept
TRL 4	Component and/or breadboard validation in laboratory environment
TRL 5	Component and/or breadboard validation in relevant environment
TRL 6	System/subsystem model or prototype demonstration in relevant environment (Ground or Space)
TRL 7	System prototype demonstration in an operations (space) environment
TRL	Actual system completed and (flight) qualified through test

8	and demonstration (Ground and Space)
TRL 9	Actual system (flight) proven through successful mission operations

4. Purpose

The purpose of conducting this readiness assessment is to show if the RFID technology is projected to the level that would stem risks for the automated checkout system implementation. The TRL Calculator is used to determine the measurements based on answering a series of questions about the RFID technology. This is comprehended by displaying the level of TRL achieved.

5. Limitations

Every method or tool has its own limitations and some issues are needed to consider. The disadvantage of using TRLs is that it is just a one dimension of technology maturity. In addition, DOD standard needs to improve the consistency and efficiency of the TRLs

For the TRL Calculator, it does not have formal verification and validation from DOD. Thus statistical validity of this tool is not yet evaluated.

6. Overview of Radio Frequency Identification (RFID) technology

6.1. What is RFID?

RFID is an automatic identification method, relying on storing and remotely retrieving data using devices called RFID tags. An RFID tag is a small sticker-like object that can be attached into a product, animal, or person. These tags contain small antennas and silicon chips which capable of transmitting a unique serial number a distance of several meters to a reading device in response to a radio frequency query.
There are three main types of RFIDs. The first type is a passive tag, which does not contain battery. This tag is simply powered by the antenna from an incoming radio frequency signal. Passive tags are the type of tag that people have inserted under their animals skin for tracking purposes. The second type of RFID is the semi-passive tag. This tag has a small battery added on to it. There is a third type

of RFID tag called an active tag which has a longer range, and larger memory capabilities than the other two types of tags.

6.2. History of RFID

The RFID technology and the subsequent RFID tags focused on this report have been around during the early twenties era that was considered the birth of radar time. Radar sent out radio waves for detecting and locating an object and it lead into the creation of Radio Frequency Identification. In 1945, Leon Theremin was the first known for inventing RFID tag for the Soviet government. Theremin's tag was more of a listening device. During WWII, radar sent out radio waves for detecting and locating an object by the reflection of the radio waves. The reflection could determine the position and speed of an object. As a result, radar's significance was quickly understood by the military. The United Kingdom used radar technology to distinguish returning English airplanes from German. At that time, radar was only able to signal the presence of the plane but not the kind of plane it was

During the 1960s through the 1980s became reality because commercial activities started using RFID. For example, Knogo Company developed Electronic Article Surveillance (EAS) equipment that had been considered the first and most widespread commercial use of RFID to provide effective anti theft measure. EAS used '1-bit' tags that could be detected only if they were presence or absence. In the 1970s, developers, inventors, companies, academic institutions, and government laboratories were beginning to work actively on RFID at research laboratories such as Los Alamos Scientific Laboratory, Northwestern University, and the Microwave Institute Foundation in Sweden. Also, the Port Authority of New York and New Jersey were applying RFID on electronic toll collection system but the successful transportation application was not ready yet. Furthermore, developmental work was focused on electronic or microwave identification systems which were intended for animal tracking, vehicle tracking and factory automation. At the end of 1970s, more companies, institutions, and individuals put more time on working RFID and the technology was improved obvious. The 1980s became the decade for full implementation of RFID technology to commercial world. The first RFID system for colleting toll was applied in 1987 in Norway and the United States followed by installing a similar system at Dallas North Turnpike in 1989. At the same time the Port Authority of NY and NJ began operated RFID for buses going through the Lincoln Tunnel.

The significant use of RFID in the 1990's was in express electronic toll business, which transmits a signal under the RFID receiver unit every time a car drives with highway speed. The first highway electronic tolling system was opened in Oklahoma in 1991. Then the first combined tool collection and traffic management system was installed in the Houston area in 1992. Later, the electronic toll system was able to integrate with neighbor toll system by able to read each other tag. As a result, regional toll agencies in the Northeastern from the E-Z Pass Interagency Group (IAG) in 1990 to develop a regionally compatible toll collection system. This system is the model for using a single tag and single billing account per vehicle to access highway of several toll authorities. Also a single tag could be used for parking lot access, fare collection, gated community access and campus access.

6.3. RFID in near Future

Today, RFID tags are used in many things. New applications are developed for gaming chips, vehicle and human accesses, theft prevention, or automated checkout systems. More importantly, RFID is mainly used in supply chain where tags, attached on items, are identified and monitored when are transferred through warehouses. This benefit could also be expanded to include the organization of inventory at the warehouse. If active tags were used, the warehouse manager would be able to know exactly how much inventory is in the warehouse at any point of time through the tags and transceivers relaying information. This might eliminate a shipping worker having to go out in the warehouse and look for the goods. Similarly, RFID tag also serves as a smart chip that informs employees when shelves have to be replenished.

Below is a diagram that shows how RFID tags identify and track items through the supply chain.

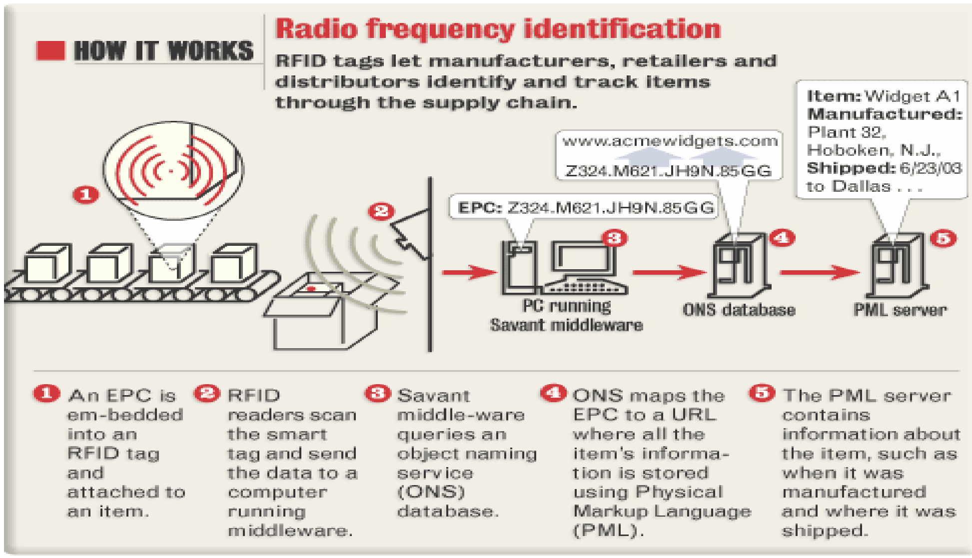

Fig 3 - RFID tags identify and track items through the supply chain

In the near future, the RFID technology will not only store information but also more observe environment surrounding it and report back to central system. There will be a “super RFID”, which combines the object identification capabilities of today’s RFID with sensor features and it can record and react to environmental condition like temperature, weight, and vibration. Some potential uses for the “super RFID” are suggested like transportation and food safety.

Transportation safety is a potential use that is every convenient and useful for drivers in future. Sensors on the ground and on other cars could be able to let our car drives itself. Besides, the “super RFID” could be used to alert drivers of possible road hazards like slick roads or pedestrian crossings.

Food safety is another excellent potential use for the “super RFID”. Imagine our refrigerator could pick up a signal from the food if it is expired. Then the fridge can tell you to throw away the expired items. This “super RFID” could also keep an inventory of what is in the fridge and inform us when items are needed to stock up again.

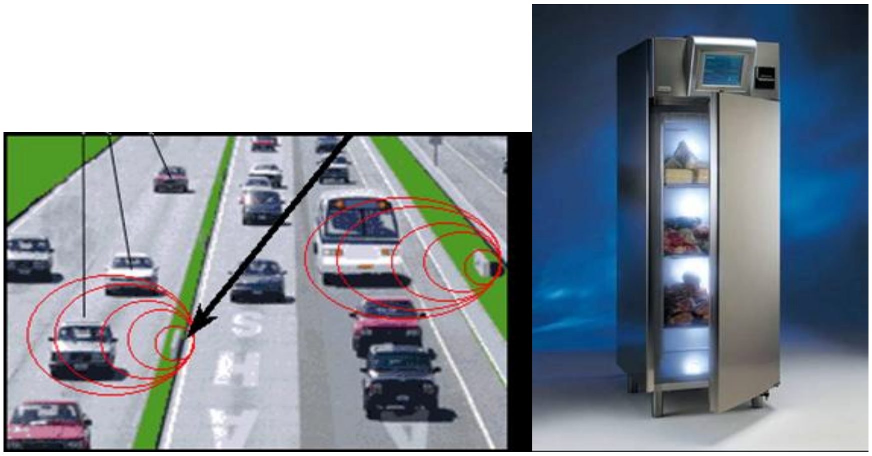

Fig 4 – Imagine having your car drive itself and your refrigerator can tell you to throw away expired items in the fridge.

7. Methods

When risk associated with immature technologies may provide warning sign for a system that require major investment. To improve the ability of RFID technology at an acceptable level for implementing the automated checkout system; TRLs is chosen to measure a gap assessment between the current RFID technology and maturity needed for a successful implementation.

The TRLs follow a scale from 1(lowest level of readiness) to 9 (mature development). A technology assessed at TRL 1 is the lowest level of technology readiness “where scientific research begins to be translated into applied research and development” [GAO/ NSIAD 99]. By the time the technology has reached the TRL 9, it has progressed through proof of concept, demonstration in a laboratory environment and realistic environment, and integration into a system. In addition, the technology at the TRL 7 maturity is considered to be acceptable risk for starting a development.

8. Instrumentation

The tool based on TRL definitions to measure maturity of RFID technology is called TRL Calculator. This tool has not undergone formal verification and validation but it is being used and has demonstrated success. The TRL Calculator is a Microsoft Excel spreadsheet application with standard set of questions about a program. Besides, it also provides "snap shot" of program maturity at a given time and a historical picture of what's been done so far.

Looking at the figure below, horizontal display shows TRL achieved either on red, yellow or green. Green shows that it has been reached the readiness while Yellow tells user that questions have not been completed; Red color shows uncompleted data entering and cannot claim attainment at this level. Level of knowledge questions can be answered by check box or % complete slider. When a user selects, he/she will get point where % complete is counted. After done with selecting for each level, % complete turns green when value is high enough to count. Besides, some question answered with "radio buttons".

The following figure shows features on the TRL Calculator

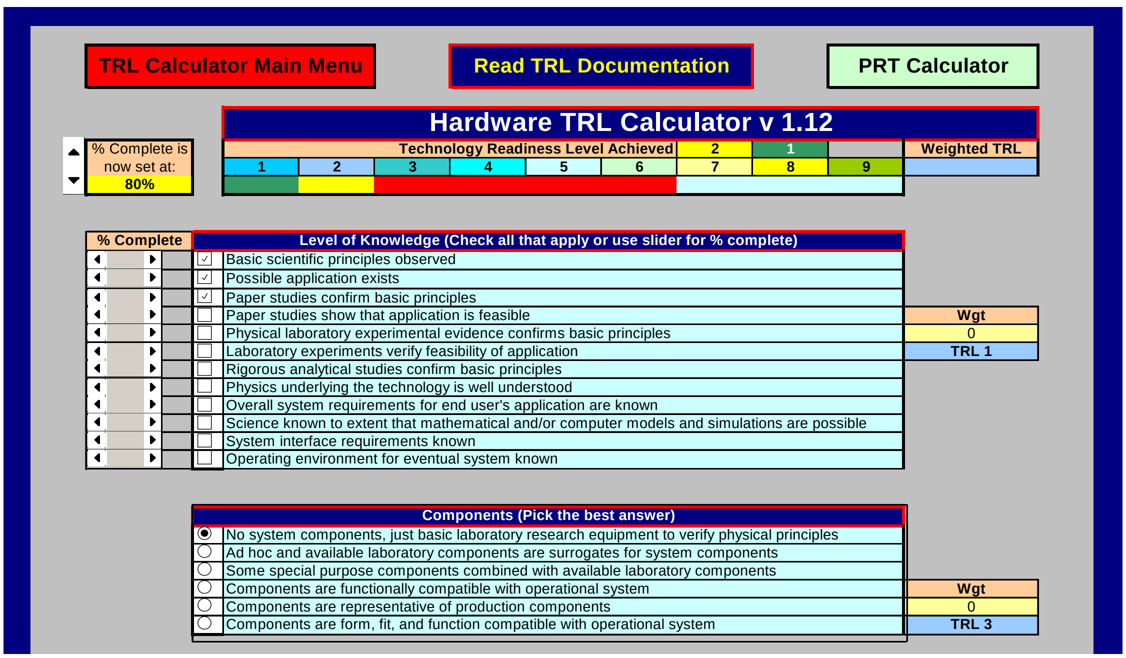

Fig 2 – TRL Calculator features

One important thing regarding how the TRLs Calculator works is that "the display will never show a greater degree of completion at a higher level than the minimum achieved below that level."[Nolte/Kennedy/Dziegiel] For example, if TRL 1 = yellow, even TRL2 could score green but will score yellow because TRL 2 tasks maturity depending on TRL1. It is important to know that TRL2 becomes green only when TRL1 tasks are changed to green. Consequently, if TRL1 task is not mature, then TRL2 cannot be mature.

9. Results

For this readiness report, the maturity of the automated checkout system's hardware and software sections are assessed. However, manufacturing and programmatic concerns are not evaluated because technical concerns are more focused for this report since this product is under development and not yet for manufacturing. The assessment spreadsheet is completed and the following table provides us some insight results.

TRL Level	Number of Questions	Number of criteria are met	Readiness Color	Is this TRL achived?
1	9	9	Green	Yes
2	16	16	Green	Yes
3	19	19	Green	Yes
4	19	19	Green	Yes
5	17	16	Yellow	Yes
6	14	13	Yellow	Yes
7	9	6	Red	No
8	9	1	Red	No
9	4	0	None	No

10. Summary

The TRLs is an assessment method that measures the level readiness of RFID technology maturity for the automated checkout system. There are 9 levels scale started from the lowest level of readiness (1) to mature development (9). The TRL Calculator is a tool to assess the readiness for each level of RFID technology.

The readiness assessment result has indicated that the levels 1, 2, 3 and 4 have been reached the readiness. For levels 5 and 6, the technology is still in yellow state because the current tags do not transmit well on certain products such as liquids or metals. This limits the overall benefit of RFID until the problem can be resolved. In addition, the automated checkout system prototype has neither been demonstrated nor completely tested in level 7 and 8. Finally, the level 9 is not achieved because the system has not been out in the market

The maturity of automated checkout system is achieved at level 6 but researchers are seeking ways to improve how the RFID tags will be able to transmit well on liquids or metals products. The RFID technology at the TRL 6 maturity is not considered to be an acceptable risk for implementing the automated checkout system.

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12. Appendix

	TOP LEVEL VIEW -- Demonstration Environment (Start at top and pick the first correct answer)
○	Has an identical unit been successful an on operational mission (space or launch) in an identical configuration?
○	Has an identical unit been demonstrated on an operational mission, but in a different configuration/system architecture?
○	Has an identical unit been mission (flight) qualified but not operationally demonstrated (space or launch)?
○	Has a prototype unit been demonstrated in the operational environment (space or launch)?
○	Has a prototype been demonstrated in a relevant environment, on the target or surrogate platform?
○	Has a breadboard unit been demonstrated in a relevant (typical; not necessarily stressing) environment?
◉	Has a breadboard unit been demonstrated in a laboratory (controlled) environment?
○	Has analytical and experimental proof-of-concept been demonstrated?
○	Has a concept or application been formulated?
○	Have basic principles been observed and reported?
○	None of the above
	Source: James W. Bilbro, NASA, Marshall SFC, May 2001

Top Level View – The RFID technology (tags, devices, network, etc.) has been tested and demonstrated. However, the automated checkout system is still under development and it has not been used yet. Therefore, a prototype will be built to test and demonstrate in a relevant environment.

H/SW Both	Ques Catgry	% Complete	☐ Do you want to assume completion of TRL 1?	TRL 1 (Check all that apply or use slider for % complete)
B	T	100	☑	"Back of envelope" environment
B	T	100	☑	Physical laws and assumptions used in new technologies defined
S	T	100	☑	Have some concept in mind that may be realizable in software
S	T	100	☑	Know what software needs to do in general terms
B	T	100	☑	Paper studies confirm basic principles
S	T	100	☑	Mathematical formulations of concepts that might be realizable in software
S	T	100	☑	Have an idea that captures the basic principles of a possible algorithm
B	T	100	☑	Basic scientific principles observed
B	T	100	☑	Research hypothesis formulated

TRL 1 - This lowest level has reached the maturity of RFID technology. All nine criteria are observed and reported in basic research and concept. Example includes studying of basic materials such as radar signals. Cost to achieve this level is very low because investment cost was borne by scientific research programs.

H/SW Both	Ques Catgry	% Complete		Do you want to assume completion of TRL 2? TRL 2 (Check all that apply or use slider for % complete)
B	T	100	☑	Potential system or component application(s) have been identified
B	T	100	☑	Paper studies show that application is feasible
B	T	100	☑	An apparent theoretical or empirical design solution identified
H	T	100	☑	Basic elements of technology have been identified
B	T	100	☑	Desktop environment
H	T	100	☑	Components of technology have been partially characterized
H	T	100	☑	Performance predictions made for each element
S	T	100	☑	Some coding to confirm basic principles
B	T	100	☑	Initial analysis shows what major functions need to be done
H	T	100	☑	Modeling & Simulation only used to verify physical principles
S	T	100	☑	Experiments performed with synthetic data
B	T	100	☑	Rigorous analytical studies confirm basic principles
B	T	100	☑	Individual parts of the technology work (No real attempt at integration)
S	T	100	☑	Know what hardware software will be hosted on
B	T	100	☑	Know what output devices are available
B	T	100	☑	Know what experiments you need to do (research approach)

TRL 2 – The second lowest level has also reached the readiness of this technology. Since basic principles are observed, the practical applications are identified. Tag devices applications like RFID tags or tag readers have been defined for this RFID technology.

Both	Catgry	% Complete		TRL 3 (Check all that apply or use slider for % complete)
B	T	100	☑	Academic environment
H	T	100	☑	Predictions of elements of technology capability validated by Analytical Studies
S	T	100	☑	Analytical studies verify predictions, produce algorithms
H	T	100	☑	Science known to extent that mathematical and/or computer models and simulations are possible
S	T	100	☑	Outline of software algorithms available
H	T	100	☑	Predictions of elements of technology capability validated by Modeling and Simulation
S	T	100	☑	Preliminary coding verifies that software can satisfy an operational need
B	T	100	☑	Laboratory experiments verify feasibility of application
H	T	100	☑	Predictions of elements of technology capability validated by Laboratory Experiments
B	T	100	☑	Cross technology effects (if any) have begun to be identified
B	T	100	☑	Paper studies indicate that system components ought to work together
B	T	100	☑	Metrics established
S	T	100	☑	Experiments carried out with small representative data sets
S	T	100	☑	Algorithms run on surrogate processor in a laboratory environment
S	T	100	☑	Know what software is presently available that does similar task (100% = Inventory completed)
S	T	100	☑	Existing software examined for possible reuse
S	T	90	☑	Know limitations of presently available software (Analysis of current software completed)
B	T	100	☑	Scientific feasibility fully demonstrated
B	T	100	☑	Analysis of present state of the art shows that technology fills a need

TRL 3 – This third level has achieved the maturity of the RFID technology. Analytical studies and experiments constitute validation of the applications/concepts formulated at TRL2. For example, RFID tags and tag readers have been achieved in testing.

Both	Catgry	% Complete		TRL 4 (Check all that apply or use slider for % complete)
B	T	100	☑	Cross technology issues (if any) have been fully identified
H	T	100	☑	Individual components tested in laboratory/by supplier (contractor's component acceptance testing)
H	T	90	☑	M&S used to simulate some components and interfaces between components
S	T	100	☑	Formal system architecture development begins
B	T	100	☑	Overall system requirements for end user's application are known
S	T	100	☑	Analysis provides detailed knowledge of specific functions software needs to perform
H	T	100	☑	Laboratory experiments with available components show that they work together (lab kludge)
S	T	100	☑	Requirements for each function established
S	T	90	☑	Algorithms converted to pseudocode
S	T	100	☑	Analysis of data requirements and formats completed
S	T	100	☑	Stand-alone modules follow preliminary system architecture plan
H	T	100	☑	Hardware in the loop/computer in the loop tools to establish component compatibility
B	T	100	☑	Technology demonstrates basic functionality in simplified environment
B	T	100	☑	Controlled laboratory environment
S	T	100	☑	Experiments with full scale problems and representative data sets
S	T	100	☑	Individual functions or modules demonstrated in a laboratory environment
S	T	100	☑	Some ad hoc integration of functions or modules demonstrates that they will work together
B	T	100	☑	Low fidelity technology "system" integration and engineering completed in a lab environment
B	T	100	☑	Functional work breakdown structure developed
			☐	

TRL 4 - The readiness at level 4 is successfully achieved. Since components like tags and tag readers are achieved in testing, basic technological elements must be integrated to establish how the devices work together to achieve level of performance. Cost to achieve is low to moderate because investment would be probably several factors greater than investment required for TRL 3.

Both	Catgry	% Complete		TRL 5 (Check all that apply or use sliders)
B	T	100	☑	Cross technology effects (if any) identified and established through analysis
B	T	100	☑	System interface requirements known
S	T	100	☑	System software architecture established
S	T	100	☑	External interfaces described as to source, format, structure, content, and method of support
S	T	90	☑	Analysis of internal interface requirements completed
B	T	80	☐	Interfaces between components/subsystems are realistic (Breadboard with realistic interfaces)
S	T	100	☑	Coding of individual functions/modules completed
B	T	100	☑	High fidelity lab integration of system completed, ready for test in realistic/simulated environments
H	T	100	☑	Fidelity of system mock-up improves from breadboard to brassboard
B	T	100	☑	Laboratory environment modified to approximate operational environment
S	T	100	☑	Functions integrated into modules
S	T	100	☑	Individual functions tested to verify that they work
S	T	100	☑	Individual modules and functions tested for bugs
S	T	100	☑	Integration of modules/functions demonstrated in a laboratory environment
S	T	100	☑	Algorithms run on processor with characteristics representative of target environment
B	T	100	☑	IPT develops requirements matrix with thresholds and objectives
B	T	100	☑	Physical work breakdown structure available
			☐	

TRL 5 – This level is not able to achieve the full readiness because of the tags' quality. Currently, the tags do not transmit well on liquid or metals products. This limited is concerned because it affects the overall benefit of RFID.

H/SW Both	Ques Catgry	% Complete		TRL 6 (Check all that apply or use sliders)
B	T	100	☑	Cross technology issue measurement and performance characteristic validations completed
B	T	100	☑	Operating environment for eventual system known
B	T	100	☑	M&S used to simulate system performance in an operational environment
H	T	100	☑	Factory acceptance testing of laboratory system in laboratory setting
B	T	100	☑	Representative model / prototype tested in high-fidelity lab / simulated operational environment
B	T	100	☑	Realistic environment outside the lab, but not the eventual operating environment
S	T	100	☑	Inventory of external interfaces completed
S	T	100	☑	Analysis of timing constraints completed
S	T	100	☑	Analysis of database structures and interfaces completed
S	T	85	☐	Prototype implementation includes functionality to handle large scale realistic problems
S	T	100	☑	Algorithms parially integrated with existing hardware / software systems
S	T	100	☑	Individual modules tested to verify that the module components (functions) work together
S	T	100	☑	Representative software system or prototype demonstrated in a laboratory environment
B	T	100	☑	Laboratory system is high-fidelity functional prototype of operational system
S	T	100	☑	Limited software documentation available
B	T	100	☑	Engineering feasibility fully demonstrated
			☐	

TRL 6 – The level 6 is affected by level 5. Since the tags do not always work, it is hard for the prototype implementing to handle large-scale realistic problems.

H/SW Both	Ques Catgry	% Complete		TRL 7 (Check all that apply or use sliders)
H	T	100	☑	M&S used to simulate some unavailable elements of system, but these instances are rare
B	T	100	☑	Each system/software interface tested individually under stressed and anomalous conditions
S	T	100	☑	Algorithms run on processor(s) in operating environment
B	T	100	☑	Operational environment, but not the eventual platform, e.g., test-bed aircraft
H	T	100	☑	Components are representative of production components
B	T	100	☑	Most functionality available for demonstration in simulated operational environment
B	T	100	☑	Operational/flight testing of laboratory system in representational environment
B	T		☐	Fully integrated prototype demonstrated in actual or simulated operational environment
B	T		☐	System prototype successfully tested in a field environment.
			☐	

TRL 7 – An actual automated checkout system prototype has not demonstrated in a commercial environment yet. Therefore, this level is red because some data are completed but not enough to claim achievement.

H/SW Both	Ques Catgry	% Complete		TRL 8 (Check all that apply or use sliders)
B	T	100	☑	Components are form, fit, and function compatible with operational system
B	T	100	☑	System is form, fit, and function design for intended application and weapon system platform
B	T	100	☑	Form, fit, and function demonstrated in eventual platform/weapon system
B	T		☐	Interface control process has been completed
B	T		☐	Final architecture diagrams have been submitted
S	T		☐	Software thoroughly debugged
B	T		☐	All functionality demonstrated in simulated operational environmenet
B	T		☐	System qualified through test and evaluation on actual platform (DT&E completed)
B	T		☐	DT&E completed, system meets specifications
			☐	

TRL 8 – The automated checkout system has not been completed in testing. The technology is immature at this level (red)

H/SW Both	Ques Catgry	% Complete		TRL 9 (Check all that apply or use sliders)
B	T		☐	Operational Concept has been implemented successfully
B	T		☐	System has been installed and deployed in intended weapon system platform
B	T		☐	Actual system fully demonstrated
B	T		☐	Actual mission system "flight proven" through successful mission operations (OT&E completed)
			☐	

TRL 9 - There is no tasks applied to this level because the automated checkout system has not gone though successful mission operations.