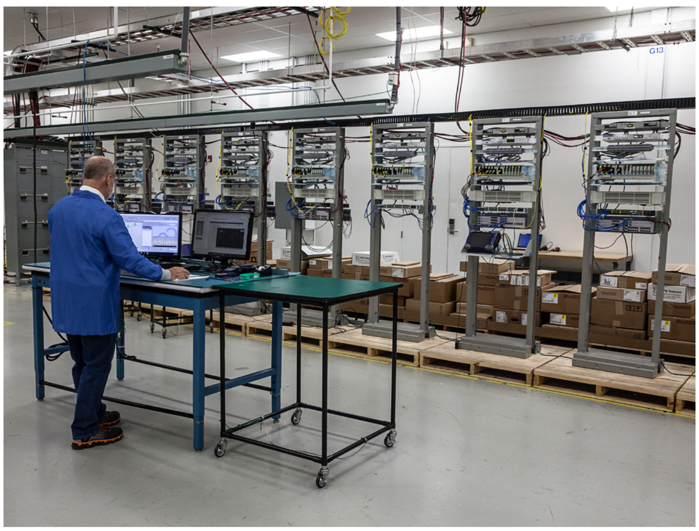
Technology Brief

Integrated Factory Acceptance Testing

New testing approach key to successful transportation network deployment



Factory Acceptance Testing (FAT) has long been a typical practice when deploying communications networks in the transportation industry. This testing serves a crucial role in deployment planning and validation of network infrastructure in order to protect the safety of passengers, employees and the general public, not to mention safeguarding operators' revenue and reputation. But networks are becoming more complex with each new technology advancement, setting the scene for a new approach to testing.

New Networks Need a Fresh Perspective

Traditionally, passenger rail and railway operators have supported discrete applications by building multiple overlay networks using a variety of transport technologies. As these networks are built, operators frequently deploy individual components verified separately from each other in laboratory conditions, via the established FAT process. However, if operators do not put those components through their paces within a fully integrated system, the consequences can lead to downtime and increased costs.

Although component testing has definite value, growing network complexity means that it is becoming increasingly challenging to identify issues before introducing live traffic. Since FAT methodologies can only identify issues related to a specific component, it is difficult to predict performance or security impact on the overall system.

Moreover, operators are looking to combine new IP-based video, voice, and data applications with support for legacy systems. Consequently, there is a trend toward more flexible converged networks versus disparate legacy and IP architectures. While this evolution helps simplify network management, it also introduces the need for greater cybersecurity measures.

Together, these factors are rapidly transforming transportation networks, driving a new approach to testing and integration. Laboratory-based, Integrated Factory Acceptance Testing (IFAT) is becoming the preferred methodology among testing professionals in a number of industries. This integrated testing approach allows rail operators to conduct more sophisticated and comprehensive validation beyond mere component-based models.

Predictable Outcomes at Lower Cost

Conducting IFAT has compelling advantages. It enables operators to save time and money, improve regulatory compliance, and increase the overall predictability of outcomes, which together significantly enhance the odds of success with integrated solutions. The IFAT approach brings together functional multivendor components and tests them in concert in a controlled environment, ensuring that particular subset of the network and security applications meet performance requirements, avoiding adverse in-service effects. As a result, IFAT leads to significantly reduced costs over the longer term and more than justifies the upfront investment.

Integrated testing also prevents costly redesign and troubleshooting during field installation, because it affords the opportunity to verify interoperability between individual systems and discover issues before installation. Pre-deployment correction is far less costly than performing fixes under the pressures of an impending completion date or, worse, after the deployment goes into operation.

Ensuring Adherence to Requirements

Likewise, IFAT combined with subsequent testing during installation provides oversight and verification to assist in meeting regulatory requirements. Upon completion of IFAT, operators and system vendors can rest assured that the integrated solution adheres to customer specifications and can be implemented without adverse effects.

Overall, because IFAT enables a reliable solution, unexpected issues when implementing resiliency and security controls can be prevented further saving time and money. And by incorporating IFAT lab testing into best practices for ongoing upgrades, proof of concept testing, training and trouble simulations, even greater cost savings are possible.

What's Involved?

Successful IFAT is a collaborative endeavor involving three groups: the customer, the vendor partners, and a neutral third party. Customer representatives are necessary to provide oversight, decision-making, and technical knowledge of the network and security systems. These representatives can also develop familiarity with the integrated solution before it is placed into operation. Stakeholders for each system/component, in addition to a security solution partner, must also be present to verify their systems are configured correctly and provide technical insight when troubleshooting the integrated solution.

A typical IFAT process takes about 12 weeks and follows these steps:

1. Develop and approve test plan
2. Rack/stack and configure hardware in laboratory
3. Validate that hardware is functioning and correctly configured
4. Conduct a formal witness test with customer and other stakeholders present
   - Testing staff reviews each test procedure with customer
   - Customer signs off on each test in turn, verifying that results comply with agreed specs
5. Disassemble racked equipment
6. Pack equipment for shipping
7. Ship to deployment site
8. Install the equipment
9. Conduct turn-up procedure and introduce live traffic

Pre-Testing and Staging

The value of integrated laboratory testing is clear in the context of pre-staging and pre-configuration. Instead of delivering unassembled equipment and configuring it onsite, hardware is tested, prepared and configured in a controlled lab environment so that it arrives on site ready for installation. Such testing cuts down on nasty surprises and puts an end to unpredictable plug and play approaches.

Traditionally, when network equipment arrives (often at one of multiple sites) an engineer may spend up to two weeks configuring, building, and checking it before deployment can be completed. Pre-staging eliminates this burden since some or all of the network can be preassembled in a laboratory, with the desired system software and configurations pre-loaded and ready to go live. Further time and labor costs are possible by preparing equipment with required labeling and asset tagging, along with the correct cabling for each product.

The value of pre-staging is the reduction in engineer time spent at a data center or communications room after onsite delivery. Now, pre-assembled and configured equipment can be ready for installation upon arrival – reducing engineers' onsite preparation workload.

Time and Cost Comparison for Pre-Staging

- **Onsite Configuration –** Two weeks with one engineer per site = $22,000 costs
- **Laboratory Pre-Staging –** Laboratory can perform multiple site configurations in one week with one engineer = $11,000 in costs
- **Onsite configuration with pre-staged equipment –** One day, one engineer per site = $2,200 costs

An Investment that Pays Dividends

IFAT Proves its Worth

The following example, based on a real-world scenario, clearly illustrates the benefits of IFAT in the field.

A rail operator dispatches two engineers to suspend the installation procedure and call technical support, only to discover that the device does not have the correct software version and the needed configuration is not supported on that device.

These engineers were scheduled to be at the site for eight hours and, assuming the site is live, a flagger is required for them to be there. Yet they spent most of the day trying to troubleshoot the cause of the errors, in consultation with remote tech support. Once the issue has been resolved and verified, a second site visit, again requiring the presence of the flagger, has to be scheduled. In many cases, this will result in a two-week delay.

The problem itself could have been avoided with integrated testing. The cost is considerable in terms of lost productivity, wasted time and project delay. The cumulative costs of similar problems can be much greater, as illustrated in the table below.

INSTALLATION DELAY COSTS		
Site Installation Cost (Per Day)	**1 Day Slip Cost**	**Total Schedule Slip**
$5400 Per Network Engineer	$10,800 (2 Engineers)	2 week average
$1500 Per Flagger	$3,000 (2 Flaggers)	
Total $6900	Total Per Day: $13,800	Probable Project Delay Penalties $$

Growing Cyber Threat Vulnerability

Digital communications networks are increasingly integrated with IT systems, which increases vulnerability to cyber-attack. The need for greater network resiliency and cybersecurity has become critical. In fact, the average annualized cost of cybercrime for the transportation industry is $7.36 million, according to the Ponemon Institute's "2017 Cost of Cyber Crime Study."

Network security affects more than just the rail system; it also affects passenger safety, revenue, and the community at large. Therefore, it is essential to incorporate resiliency and cybersecurity measures into the network from the earliest stages of design, rather than risk the consequences of disruption or the cost of retrofitting multiple systems.

Without integrated testing, latent issues related to the operation and maintenance of failover and security controls may not become apparent until installation. Verification in a lab facility can mitigate these issues before deployment, enabling any necessary redesign and troubleshooting to be completed in a controlled environment.

The Cost of Downtime

Many organizations do not fully understand the impact of network outages on their business. Calculating the cost of downtime can be difficult because it requires an understanding of both tangible and intangible losses. Tangible losses are quantifiable, hard costs that include lost revenue, costs to recover lost information, disaster recovery and business continuity costs. Intangible costs include damage to an operator's reputation, lost customers and lost employee productivity. In fact, the damage caused by intangible costs can be greater than for tangible costs.

A Worthwhile Investment

An integrated testing strategy requires upfront investment in a lab facility, which may seem hard to justify at first. However, IFAT is more economical and practical over both long and short-term than traditional field testing, especially when intangible savings, such as reduced downtime and improved passenger satisfaction, are considered.

Ultimately, IFAT methodology is the best practice to pursue in order to achieve successful and predictable outcomes whenever new elements are integrated into a transit agency or railroad's communications networks. There is far too much at stake—revenue, safety, and reputations—for it to be otherwise.

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