GENERAL DYNAMICS
Canada

Sustaining Capabilities and Mission Availability

Key *Requirements* for a Performance-based In-Service Support Program

Abstract

Prior to the 1980s, military organizations had internal teams dedicated to managing every aspect of In-service Support (ISS) for all platforms. Throughout this period, most of these teams struggled with three major challenges associated with sustaining effective ISS: a responsive supply chain, available engineering services, and effective training. These challenges still exist today and, to truly address these challenges, military organizations need a single integrated ISS program, which provides access to engineering and logistics support capabilities that can be applied to overall platform life cycle support requirements, addressing the key noted challenges. This can only be achieved with an ISS program built on performance-based management principles, which monitor and adapt to product sustainability measures in real time to meet operational readiness objectives.

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Maintaining Operational Readiness

The single most pervasive fact that every defence organization in the world must deal with on a daily basis is that all the complex hardware that has been deployed to support operations must be carefully maintained. No matter how powerful and capable a platform is, it is useless unless it is ready to perform as expected when required. Therefore, maintaining the operational readiness and tactical performance capabilities of every platform is a top priority for all military organizations. With an efficient support program, commanders can rest assured that all platforms — air, land, and sea — will perform to their full potential during any in-field operation.

However, maintenance support requirements are complicated. Today's platforms are an amalgam of integrated mechanical and electronic hardware managed by complex operations and communications software. As these integrated systems become more complex and the individual components that make up their capabilities become more integrated with each other, the importance of efficient and effective support programs increases exponentially. Exacerbating the issue is the fact that most military platforms have lengthy in-service lives. As a result, maintaining operational readiness requires extensive support programs for each component, as well as access to the hardware and software knowledge required to sustain the program throughout an extended life cycle.

Until recently, military organizations took full responsibility for platform support. When required, they would contract suppliers for specific capabilities. With this approach suppliers provided limited logistics and engineering services rather than end-to-end support. As a result, the military organization retained responsibility for the integration of logistics and engineering support functions within and between systems.

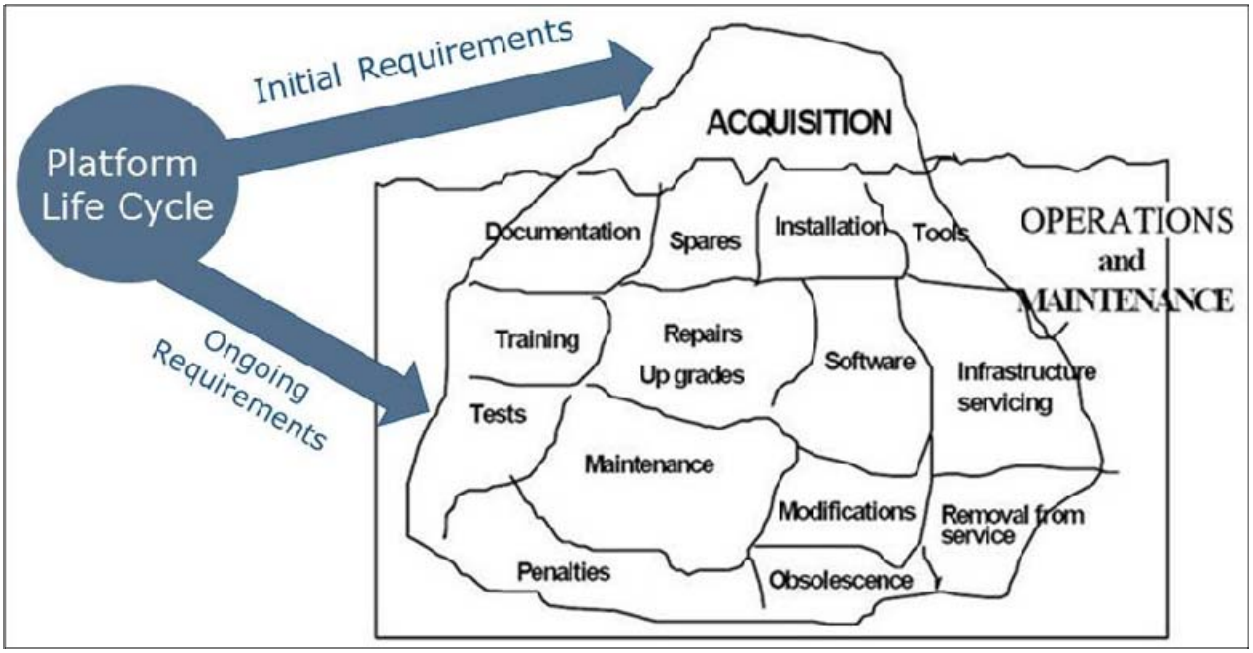
Unfortunately this practice is no longer tenable. Budgetary and personnel resource restraints make it almost impossible for most military organizations to efficiently ensure the operational readiness of platforms in the short and long term. Therefore, most organizations are now turning to external suppliers for more effective in-service support (ISS) options.

The ideal ISS program is one that eliminates the maintenance support risks for a platform at the segment and at the life cycle level. Structured properly, it ensures effective supply chain management that guarantees the availability of spares when required. It includes ongoing product and system training that enables in-field personnel to leverage the full capabilities of a platform's integrated systems. Most importantly, it provides the engineering knowledge and expertise to address end-to-end support requirements on a platform for individual components and fully integrated systems.

The In-Service Support Challenge

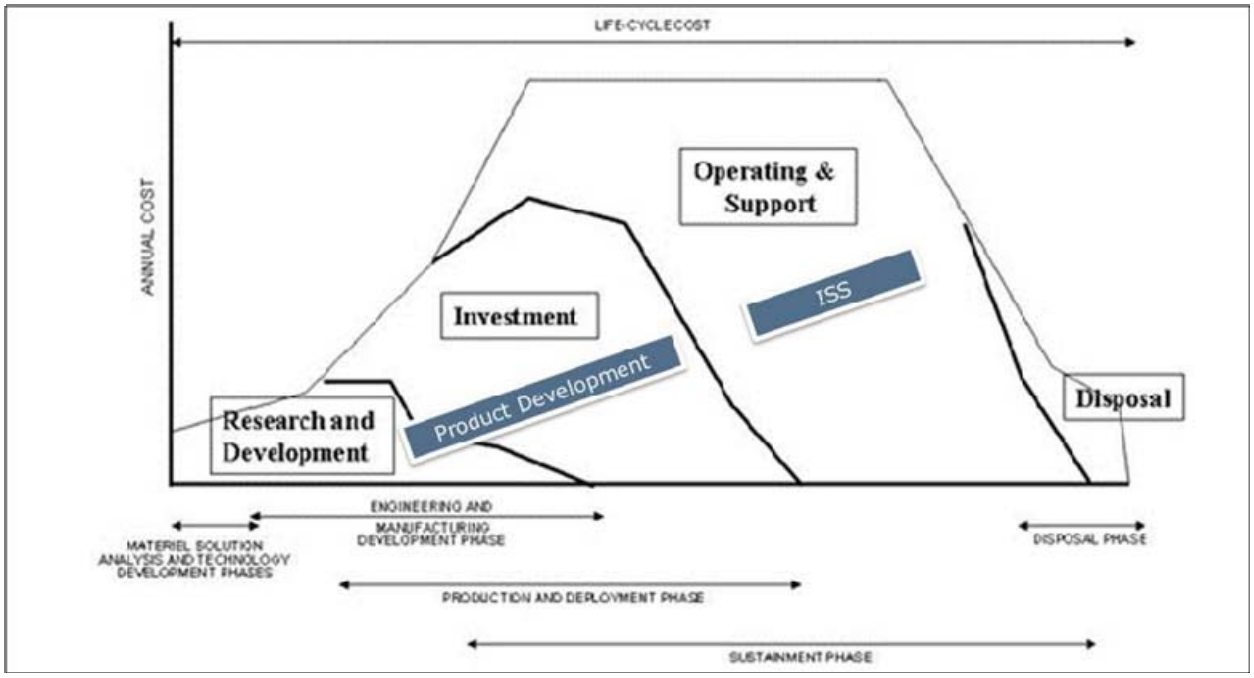
In-service support (ISS) refers to all activities, including, but not limited to, engineering, maintenance, logistics and training services and related management functions, necessary to maintain a platform throughout its service life. To establish effective ISS programs, military organizations and their suppliers must address platform requirements beyond the initial product and system development and acquisition phase, which is really just the tip of the iceberg when it comes to a product and platform's life cycle (Figure 1). As a platform goes into service, maintenance and operations requirements can include everything from documentation, spares, installation and tools, to training, repairs, upgrades and modifications. And these requirements must be supported properly to maintain the operational readiness of the platform.

Figure 1: System development and acquisition is the tip of the iceberg of platform's life cycle requirements



Given this reality, it's not surprising that the operations and maintenance requirements for every platform account for a majority of its annual and life cycle costs (Figure 2). Although initial investments for research and development are usually quite substantial, military organizations incur the bulk of expenditures related to a platform through their efforts to ensure the platform is ready to perform as expected when required.

Figure 2: Operations and maintenance requirements account for a majority of a platform's annual and life cycle costs



Prior to the 1980s, military organizations did the lion's share of the ISS work themselves. They had internal organizations whose sole purpose was to manage every aspect of ISS for all platforms. These organizations usually arranged transportation to and from a repair venue, sourced and provided all spares, maintained databases of all relevant technical data, and purchased and operated special tools and test equipment, when required. Often, they were also responsible for engineering and configuration management support and only brought in external contractors for specific logistics or engineering services. As a result, these organizations assumed all the responsibility, risk and cost associated with ISS. This allowed the organization to retain control of the ISS process and ensure that all platforms were maintained to the strictest operational standards.

But this approach also resulted in a few unintended and unwanted side effects. The practice of contracting external suppliers for specific requirements created a fragmented defence industrial base populated by suppliers who had little incentive for innovation and better performance. Accountability for component and system performance was reduced because responsibilities were spread among several independent contractors who were not directly involved in determining the platform's overall performance and maintenance requirements. As a result, when issues did arise, it was often difficult to identify root causes of a problem. In addition, this approach also proved to be relatively resource-intensive, often creating a considerable burden on limited budgets. Most importantly, it proved to be operationally ineffective, often resulting in poor equipment availability and, therefore, low operational readiness.

Throughout this period most military organizations continued to struggle with three major challenges associated with effective ISS.

Supply Chain Responsiveness

One of the biggest challenges associated with a truly effective ISS program is having the spares required to keep a platform working as intended in the field. To maintain operational readiness, military organizations must ensure that the right parts are on hand when needed. Therefore, high levels of asset availability and reliability must be maintained without incurring excessive costs due to oversupply. And availability must be ensured through detailed usage tracking that helps organizations avoid over-maintaining parts or retiring spares early. This requires integrated systems and processes that enable ongoing tracking and monitoring of the components and systems that make up a fully operational platform.

Unfortunately, most military organizations don't have a method of tracking, monitoring, and guaranteeing the availability of compatible hardware and software required to maintain all of a platform's complicated systems. In addition, most external contractors can't provide supply chain management services and assurances. Some don't have the experience required and, therefore, can't provide the supply chain security needed. Others make general products for general applications, rather than specific products for specific military applications, so they can't guarantee component availability. And most don't have the processes and, therefore, can't guarantee the supply chain for their products for the full life cycle of a specific platform.

Engineering

In addition to ensuring spares are available when needed, military organizations must also ensure comprehensive engineering support is available that can address all aspects of a product that is sold into any platform. The extended life cycle of most platforms dictates that engineering support will be required long after a system is purchased. That support must not only address regular maintenance requirements, but future upgrades and modifications.

Historically there have been unclear lines of responsibility with respect to the engineering support requirements for most platforms. Despite the fact that military organizations have retained accountability for ongoing maintenance, there has been confusion on both sides of the relationship about who is ultimately accountable for engineering support when things go wrong at the system and component level. Under traditional contract/supplier relationships, most suppliers will provide military organizations with a component that is integrated into a system by a system integrator. When a component fails or requires repair, the military organization will turn to the system integrator for support. But the integrator may not have the engineering capabilities needed to address the specific component and, therefore, can't provide the engineering expertise to address a specific problem.

To keep platforms working in the field, military organizations require ready access to full engineering capabilities that can be harnessed throughout the life cycle of a product. This includes:

- **Maintainability engineering**, which is the process of engineering maintainability into the design of a component or system to ensure ease of maintenance in the field (e.g., access the battery without removing the roof)
- **Reliability engineering**, which is the ability to provide the engineering required to ensure the component won't malfunction once it is in field and, when it requires repair, that the repair is engineered so the component won't cause problems again
- **Logistics engineering,** which defines the design of the support system required to address all the problem areas and ensure ongoing support requirements are met in each area

Training

Finally, even if military organizations have been able to address supply chain and engineering challenges, most have also had to struggle with the need to ensure personnel receive comprehensive training on all components and systems. In most situations, the ability of a contractor to provide engineering services for a product during the development phase of a platform has been confused with the ability to convert that expertise into effective life cycle training support. Most suppliers are not equipped to transfer the knowledge of their engineering teams into an effective training program that can be readily digested by external trainees. Plus, if they do provide training, most suppliers do not have the infrastructure to support ongoing updates that address upgrades and modifications to specific components or systems.

Complete Support

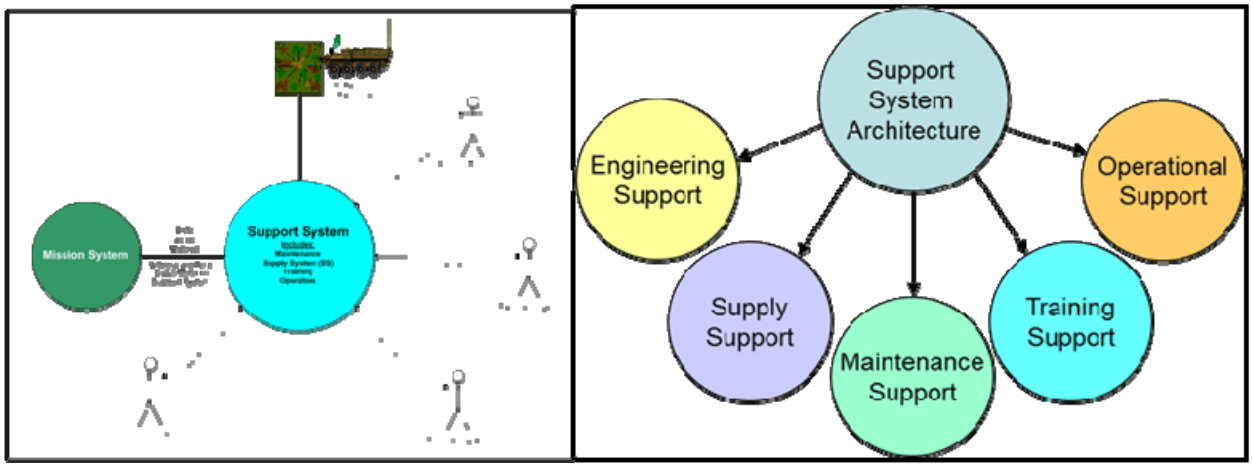
There are suppliers who claim they can provide ISS program support that addresses each of the three main challenges. However, most of these suppliers are not equipped to truly address the logistics, supply chain, engineering and training challenges under a complete integrated program. Most don't have the engineering design capability. Some sell packaged ISS solutions, which don't adequately address all requirements. Others offer programs to address one or two requirements, but cannot tackle the major challenges as a whole.

To truly address these challenges, military organizations need access to engineering capabilities that can be applied to the overall life cycle support requirements and all problem areas through a single integrated ISS program. And that program must be structured to ensure support is provided as expected and when required. This can only be achieved with an ISS program built on performance-based management principles, which monitor and determine product sustainability requirements in real time to meet operational readiness objectives.

Elements of Effective In-Service Support

A performance-based ISS program ensures operational readiness of all platforms by providing cost-effective maintenance and support throughout a platform's entire life cycle. It addresses engineering support, supply support, maintenance support, training support and operational support elements with a long term, total system support solution, which integrates the elements of a support system into an effective infrastructure for optimal mission and support system implementation (Figure 3).

Figure 3: An integrated ISS program approach



Fleet-centric Support

To truly address operational readiness requirements, the ISS program should be fleet-centric and all encompassing. It should be designed to address the support needs of all equipment being procured as part of an organization's capital acquisition projects. This includes the platforms, along with any specialized tools, support and test equipment, simulators, training aids and IT hardware and software.

Clear Accountability

To ensure effectiveness, and avoid any potential for confusion of roles and responsibilities, the program should clearly define the accountability of the supplier and the military organization. In this way, the rules of engagement can be understood from the outset by both sides of the relationship and the supplier can apply the resources needed to ensure all performance requirements are met.

Results-based Performance

Structured this way, the program should be results-based. It should be built around clearly defined expectations the purchaser has of the supplier, and the effectiveness of the supplier should be determined based on performance measures and standards that define how well expected results are to be achieved. Therefore, expected results should be quantifiable, so that performance can be based on quantitative data that allows both purchaser and supplier to make an objective performance assessment at any time. This requires performance measures for equipment reliability and maintainability based on historical or projected performance standards.

Positive and Negative Incentives

As with any performance-based system, the ISS program should include positive and negative incentives that can be used to reward the supplier for meeting performance targets, or penalize the supplier for failing to meet contracted Key Performance Indicators (KPIs). For most situations, a combination of financial (award fee) and non-financial incentives (award term; evaluation criteria for future business to include past performance) may be used.

Penalties should be sufficiently punitive to get the supplier's attention, but not so harsh that they reduce motivation or severely affect the supplier's business operation. Positive incentives should be used where performance exceeds contractual requirements.

Long Term Relationship

Given the extended life cycle of military platforms and the systems and components that enable them, the ISS program should be based on a long term relationship. Typically, this type of program should be structured around the Estimated Life Expectancy (ELE) of the specific platform that requires support.

Scalability

In addition, to provide both supplier and contractor with the flexibility to address future support requirements and contingencies, the ISS program should include the ability, at a known cost, to increase or decrease activity levels consistent with the contractor's operational requirement.

Integrated Support Capabilities

Finally, the total system approach required for an ISS program based on these criteria must be backed by a supplier with integrated support capabilities. The ideal supplier must have the organization to address all product/platform requirements beyond the acquisition phase and, throughout the extended life cycle of the platform, its systems, and its components. This can only be achieved by organizations that have the core capabilities (Figure 4) to address the base of the platform iceberg.

Figure 4: Core capabilities for complete, integrated ISS program

GD Canada and ISS

General Dynamics Canada has the largest and most comprehensive logistics and support systems engineering team in Canada. With more than 130 engineers and analysts spread across the nation in facilities in Calgary, Ottawa and Halifax, the General Dynamics Canada Integrated Lifecycle Support Services (ILSS) team designs, develops and delivers ISS solutions for ground, maritime and airborne platforms. This team develops support solutions on a wide variety of performance-based contract frameworks, including:

- Contractor logistics support
- Through life support
- Performance-based availability
- Performance-based logistics

Complete ISS Services

Through these contract frameworks, General Dynamics Canada provides complete ISS services, which include:

- **Weapons System Engineering Management (WSEM)**, which is structured to comply with ISO/IEC 15288 System Engineering Life Cycle Processes guidelines and provide a management framework within which all technical and engineering support functions are delivered
- **Technical Problem Management (TPM)**, which is tied directly to a performance-based availability program and monitored for performance associated with all technical problem solving support system projects within the ISO/IEC 15288 framework
- **Engineering Support Services (ESS)**, which include all systems, hardware and specialty engineering disciplines to provide cost-effective, leading edge technical support
- **Software Support Services (SSS)**, which provide fast turnaround problem solving, bug fixing and technical investigation, and ensure customers are fully connected with change processes through regular releases of an operational software suite
- **Supply Chain Management Services (SCMS)**, which leverage the latest SCM tools and services to ensure that spare components are always available and deployable
- **Training Support Services (TSS)**, which provide reliable, easy-to-use training systems and training
- **Technical Air Worthiness Support (TAWS)**, which ensures that the flight integrity of air platforms is maintained

Field-proven Support

Military organizations around the world rely on this complete portfolio of ISS services to maintain the operational readiness of their platforms. For example, General Dynamics Canada provides complete ISS services that support Canada's fleet of maritime patrol helicopters. Through the CH-148 Cyclone ISS Program, General Dynamics Canada provides comprehensive life cycle support to the CH-148 Cyclone helicopter.

The CH-148 Cyclone ISS Program includes complete ISS services, as well as infrastructure development services, such as:

- **Maritime Helicopter Avionics Electronics Integration Environment (MHAEIE)**, which is a systems integration lab used as an engineering test bed for all system modifications, upgrades and changes for all sensor stimulators and simulators, data management systems, consoles and displays, environment modelers and world simulators
- **Software Support Facility — Software Development Environment (SDE)**, which is a fully integrated software tool used to maintain and develop performance enhancements to operational code and enable the software support team to release new versions of operational software on an 18 month cycle

- **Electronic Warfare Operational System (EWOS)**, which provides a hot-bench system that includes self-defence and electronic support measures systems that can be used for electronic warfare requirements definition, verification and validation
- **Mission Preparation and Analysis System (MPAS)**, which provides a portable, high fidelity mission planning and debriefing platform that can be used by aircrews to plan and debrief missions

In addition to complete support and infrastructure development, General Dynamics Canada provides training services, which include:

- **Maritime Helicopter Training System (MHTS)**, which employs training equipment, prime mission equipment (PME), support equipment, enabling systems, courseware, training information management systems (TIMS) and related services
- **Operational Mission Simulator (OMS)**, which provides a mission simulator (MS) designed by General Dynamics Canada for crew tactical training, and a flight simulator (FS) designed by Rockwell Collins Simulation & Training Solutions for pilot flight training
- **Mission Procedures Trainer (MPT)**, which is a reconfigurable training system that provides aircrew procedures training for individual, group, part-crew, and multiple part-crews as a prelude to full-crew training in the OMS
- **Aircraft Maintenance Trainer Lower (AMTL)**, which provides the facility for maintenance training of aircraft avionics and Integrated Mission System (IMS) avionics
- **Weapon Load Part Task Trainer (WLPTT)**, which is used by operational squadrons to refresh loading crew skills and qualify personnel in the loading of ordnance
- **Training Courseware Development,** which provides training program documentation and courseware

The ISS Program is built upon a 20 year, firm fixed Performance-based Availability framework, and is fully compliant with ISO/IEC 15288 System Engineering Life Cycle Processes.

Conclusion

With an efficient and effective ISS program, military commanders can maintain the operational readiness and tactical performance capabilities of every platform. Given the complexity of today's integrated platforms, the ideal ISS program is one that eliminates the maintenance support risks for a platform at the segment and at the life cycle level. Structured properly it ensures effective logistics and supply chain management that guarantees the availability of spares when required. It includes ongoing product and system training that enables in-field personnel to leverage the full capabilities of a platform's integrated systems. Most importantly, it provides the engineering knowledge and expertise

to address end-to-end support requirements on a platform for individual components and fully integrated systems.

This can only be achieved with an ISS program built on performance-based management principles, which monitor and determine product sustainability requirements in real time to meet operational readiness objectives. A performance-based ISS program ensures operational readiness of all platforms by providing cost-effective maintenance and support throughout a platform's entire life cycle. It addresses the logistics support, supply chain, engineering and training challenges with a long term, total system support solution, which integrates the elements of a support system into an effective infrastructure for optimal mission and support system implementation.

The foundation of GD Canada's system is a measurement management and reporting system that is focused on the key performance indicators (KPIs) that directly impact delivery of contracted services levels. GD Canada uses a combination of Oracle based support modules, integrated with a SharePoint collaborative environment to collect, analyze and respond to performance trends before they become problems. Our closed loop performance management process ensures that performance information is fed back resulting in optimization of business processes throughout services life-cycles.

In summary, a truly effective ISS program needs to be performance based and address platform requirements beyond the initial product and system development and acquisition phase, which is really just the tip of the iceberg when it comes to a product and platform's life cycle.

Acronyms

Term	Definition
AMTL	Aircraft Maintenance Trainer Lower
ELE	Estimated Life Expectancy
ESS	Engineering Support Services
EWOS	Electronic Warfare Operational System
ISS	In-service Support
KPI	Key Performance Indicators
MHAEIE	Maritime Helicopter Avionics Electronics Integration Environment
MHTS	Maritime Helicopter Training System
MPAS	Mission Preparation and Analysis System
MPT	Mission Procedures Trainer
OMS	Operational Mission Simulator
SCMS	Supply Chain Management Services
SDE	Software Development Environment
SSS	Software Support Services
TAWS	Technical Air Worthiness Support
TPM	Technical Problem Management

TSS	Training Support Services
WLPTT	Weapon Load Part Task Trainer
WSEM	Weapons System Engineering Management

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