A CRITICAL REVIEW OF THE INTEGRATED LOGISTICS SUPPORT SUITE FOR AEROSPACE AND DEFENCE PROGRAMMES

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ABSTRACT

The Integrated Logistics Support (ILS) can be described as an approach for optimisation of in-service (logistics) activities and minimisation of the life cycle costs of a system. ILS is an integral part of systems engineering in aerospace and defence programmes.
More recently, the Aerospace and Defence Industries Association of Europe (ASD) has released a broad set of specifications for ILS, the so-called ASD ILS Suite. Most of these specifications are published in cooperation with the Aerospace Industries Association of America (AIA) and one specification with AIA and the Airlines for America (A4A). Thus, the ASD ILS Suite is recognised and used in the largest aerospace and defence markets.
The aim of this paper is to present the results of a critical review on the readiness of the ASD ILS Suite for its applicability in aerospace and defence programmes.

Keywords: Integrated Logistics Support (ILS), Systems Engineering (SE), In-Service Support (ISS), Design for X (DfX), Product Lifecycle Management (PLM)

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1 INTRODUCTION

Aerospace and defence (A&D) programmes are responsible for the management of aircraft and weapons systems. These are complex systems (of small fleets[1]) with long life cycles (Mas *et al.*, 2015). Over the last few years, A&D programmes have exceeded their anticipated time-to-delivery, (life cycle) costs and suffer from low fleet availability (cf. BMVg, 2018).

One reason might be the design. Upon end of the design phase[2] more than 70% of life cycle costs are fixed, and with completion of the production up to 95% of the entire life cycle costs are fixed (Eigner and Stelzer, 2009; Brusa, Calà and Ferretto. 2018). This implies that poor planning in the design phase results in poor performance during the in-service phase of systems. As a possible consequence, for A&D systems, greater focus was and still is being put on in-service (logistics) activities through greater consideration of in-service aspects during system development.

In the field of defence, in 1973 the concept of a logistics support analysis (LSA) for a system's development with regard to the in-service phase was introduced by the United States Department of Defense with Military Standard (MIL-STD)-1388 (cf. US DOD, 1993a, 1993b). While MIL-STD-1388 was cancelled in favour of Military Handbook 502 in 1997 (US DOD, 1997) other nations followed with their own national standards. The United Kingdom Ministry of Defence introduced DEF STAN 00-60 in 1996 (cf. UK MOD, 2002) which was superseded by DEF STAN 00-600 in 2010, while the Australian Department of Defence (AU DOD) produced DEF(AUST)5692 in 2003.

Eventually, the Aerospace and Defence Industries Association of Europe (ASD) in cooperation with the Aerospace Industries Association of America (AIA) introduced international specification S3000L for LSA in June 2010. However, this was not the first contribution to the broader set of specs, the so-called S-Series Integrated Logistics Support (ILS) specifications[3]. By the 1980s, the ASD's predecessor, the Association Européenne des Constructeurs de Matériel Aérospatial (AECMA), had published the specs STE100, S1000D, and S2000M. The most (relevant) specs for the ASD ILS Suite were issued until 2018. (ASD ILS Spec Council, 2017)

The aim of this paper is to present the results of a critical review on the readiness of the ASD ILS Suite for its applicability in A&D programmes. In addition, it may promote ILS outside (classified) military research for encouraging new ideas and the enrichment of ILS.

2 STATE-OF-THE-ART INTEGRATED LOGISTICS SUPPORT

In order to describe the context of the ASD ILS Suite, other available standards and literature are used to describe the current state of ILS.

The concept of ILS was created in the US DOD back in 1964 (Babbitt, 1975, p. 1).

Around that time the US DOD (1971, p. 3) defined ILS as "… a composite of all the elements necessary to assure the effective and economical support of a system or equipment at all levels of maintenance for its programmed life cycle. As used herein, the term encompasses the consideration of these elements during the system/design engineering process, the procedures for analyzing and documenting these considerations, and the process of planning for and acquiring these elements on a timely basis."

In 1993 the US DOD (p. 107) changed the definition of ILS to "A disciplined approach to the activities necessary to: (a) cause support considerations to be integrated into system and equipment design, (b) develop support requirements that are consistently related to design and to each other, (c) acquire the required support; and (d) provide the required support during the operational phase at minimum cost."

In 2003 the AU DOD chose another definition for its DEF(AUST)5692 (p. v of glossary): "ILS is a disciplined and iterative approach to materiel management aimed at minimising LCC[4] for a Materiel System while ensuring that preparedness requirements are met. ILS includes processes for influencing equipment design and for determining requirements to achieve supportable and supported equipment."

And in 2011 NATO (p. A-1) defined ILS as "… the management and technical process through which supportability and logistics support considerations of materiel (hardware or software) solutions are

[1] Here: Total number of one kind of system in operation.

[2] Also development phase.

[3] Also ASD Suite of ILS Specifications, ASD ILS Suite or ILS Suite.

[4] Life cycle costs

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integrated from the early stages and throughout the life cycle of an armament programme and by which all elements of logistics support are planned, acquired, implemented, tested and provided in a timely and cost-effective manner." The NATO Logistics Handbook (2012, p. 184) provides another definition, but this is not quotable as stated in its foreword owing to a missing formal agreement.
Also, organisations outside A&D have adopted ILS and provide their own definition: "The management, engineering activities, analysis, and information management associated with design requirements definition, material procurement and distribution, maintenance, supply replacement, transportation, and disposal that are identified by space flight and ground systems supportability objectives." (NASA, 2016 p. 217).
Although these definitions are not identical, they are still concurrent. A consolidated definition is possible. Thus, the basic elements of ILS are:

- The management of a system and
- the iterative optimization of supporting activities
- for minimization of life cycle costs
- at the required performance level
- from engineering during the entire life cycle.

The second-last bullet point is implied through the afore listed aspects and for the sake of procuring systems with certain requirements for a dedicated use.
To achieve this, each A&D programme has one single ILS Plan which describes how ILS will be conducted during the life cycle. This includes planning data and information, responsibilities, resources, etc., for the successful execution of ILS (US DOD, 1971, p. 7 f.).
ILS encompasses the entire life cycle from pre-concept through concept, development, production, and utilisation/support to retirement (NATO, 2011, p. B-1). Some minor variations to the phases can be found in MIL-STD-1388-1A (p. 52 ff.) and DEF(AUST)5692 (p. 3D-2 ff.).
The starting point for planning of ILS activities for the utilisation/support phase is the LSA in the development phase.
The definitions of LSA vary across organisations as those for ILS (cf. US DOD, 1971 p. 8 f.; AU DOD, 2003, p. vi of glossary; NATO, 2011, p. A-2). As an example, the definition of the US DOD (1993a, p. 107) is: "The selective application of scientific and engineering efforts undertaken during the acquisition process, as part of the system engineering and design process, to assist in complying with supportability and other ILS objectives."
For the LSA the first step is the identification and integration of tasks into the LSA Plan (US DOD, 1993a p. 12 ff.). LSA tasks can comprise f.ex. operations, maintenance level, reliability, availability, maintainability, failure mode effects and criticality analysis, task inventory, task analysis, maintenance plan, personnel, personnel skill, training materiel, support equipment, packaging and provisioning, transportability, life cycle costs and further (AU DOD, 2003; US DOD, 1993b).
The outcome of the analyses of these tasks comprises consistent and detailed data elements and information. These have to be saved in a document called an LSA record which has a special format (US DOD, 1993a, p. 4; 1993b, p. 11 ff.). This format enables the contracting organization to more easily process and (cross-)check the data and information which should be updated during the entire life cycle (US DOD, 1993b, p. 1 ff.). Such iteration is likely to improve the reliability of the LSA record and so to enhance the performance of a system and minimize life cycle cost.
Although there is some (commercial) literature for ILS (and LSA), the methods mostly refer to military standards (e.g. Jones, 2006; Biedenbender, 1993). Blanchard (2003) used the term Logistics Engineering to describe the design of the prime mission equipment for supporting the overall capability of a system as an inherent part of the overall system engineering process. However, that term has moved into background during over time.

3 RESEARCH APPROACH

This research on ILS can be split into three phases.
In the past, the awareness of the problem concerning excess time and money, and a low fleet availability for (joint) A&D programmes, was raised. From that point in time parts of the ILS Suite, namely S1000D, S2000M and S3000L were studied. S2000M was actively used and applied for almost three years. During this time some impact by decisions and actions could be made on the material management of a defence programme within the scope of the spec and of the limitations of

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the post. Through this participation and observations, this phase can be described as qualitative field research (Döring and Bortz, 2016, p. 184 f., 205 ff.).
There was a slight overlap between first and second phases. The second phase was an intensive study of the ASD ILS framework, particularly S1000D, S2000M and S3000L. Other military ILS standards were studied as well. Personal observations were exchanged and compared with the observations of colleagues and discussed (N.N., 2017). This research element was qualitative and empirical. (Döring and Bortz, 2016, p. 184 ff.).
In the beginning of the last phase a literature research was conducted for several reasons. First, the existing information and specs needed to be checked that they were up to date and then updated if required. Second, the spec information was correlated for better understanding, presentation and comparison. Third, other (scientific) literature and papers on ILS and associated fields were reviewed. The research elements of the last phase were qualitative and theoretical in nature (Döring and Bortz, 2016, p. 184 ff.).
Finally, the different findings were consolidated, and the readiness of ILS for A&D programmes assessed. The research can be best described as qualitative applied research (Döring and Bortz, 2016, p. 184 ff.).

4 THE ASD ILS SUITE

An excerpt of the organization of ASD is presented before the ILS Suite is discussed.

4.1 The ASD structure - excerpt

ASD is an association of European Aeronautics, Space, Defence and Security Industries with over 3,000 companies employing 843,000 people, combined generating a turnover of 220 bn EUR in 2016.[5]
ASD's working bodies are spread across a matrix consisting of four sector-focused business units (civil aviation, defence, security and space) and six commissions/cross-functional-areas (environment, research & technology, legal & trade, supply chain & SMEs, services and external affairs).[6]
The ILS Spec Council belongs and reports to the ASD Services Commission within that structure.
Each of the ILS disciplines has a steering committee (SC) which is represented in that ILS Spec Council that links to the ASD and AIA. The S1000D is an exception due to its own S1000D Council for the additional inclusion of the Air Transport Association (ATA)[7]. The ASD-STE100 is an ASD-only spec and so is organised within the separate STE Maintenance Group under the ASD. Three more working groups for data model & exchange (DMEWG), for terminology (TWG) and for the bike-example (BWG) exist under the ILS Spec Council. All three working groups link to the SCs (except S1000D SC). (ASD AIA, 2016b. ch. 4 p. 3 ff.; ASD ILS Spec Council, 2017, p. 2)
Thus, the ILS Suite is coordinated under the umbrella of the ILS Spec Council.

4.2 Overview of the ASD ILS suite

The ASD ILS Suite can be split into three groups of specs. The first one contains specs which relate to one individual ILS discipline (S1000D, S2000M, S3000L, S4000P, S5000F, S6000T). The second group are complementary specs with general topics relevant to all specs of the first kind (ASD - STE100, SX000i, SX001G, SX002D, SX004G, SX005G). The third sort are input data specs for every ILS discipline (S1000X, S2000X, S3000X, S4000X, S5000X, S6000X). (cf. ASD ILS Spec Council, 2017)
All published specs are free of charge. The newest and most of the replaced issues can be downloaded from the specs' websites. All available specs have been published by ASD, most in cooperation with the AIA and only the S1000D in cooperation with AIA and the ATA. Though the ILS-Suite is not complete as there are still specs in production.
The following table provides an overview of all (published and planned) specs:

[5] https://www.asd-europe.org/about-us/asd-at-a-glance (accessed 22/11/2018).
[6] https://www.asd-europe.org/about-us/structure; https://www.asd-europe.org/sectors-policies/services (both accessed 22/11/2018).
[7] Now Airlines for America (A4A)

Table 1. *Overview of ASD ILS Specifications*[8]

Spec	Field	Issue	Pages / MB	Issue Date	Responsible Body	Website	Publisher
The S-Series of ILS Specifications - Overview			22 / 0,7	March 26, 2017	ILS Spec Council	sx000i.org	
ASD - STE100	Simplified Technical English	7.0		January 25, 2017	STEMG	asd-ste100.org	
S1000D	Technical Publication	4.2	3,547 / 45,7	December 31, 2016	S1000D Council and SC	s1000d.org	ASD, AIA, ATA
S2000M	Material Management	6.1	844 / 12	March 1, 2017	S2000M SC	s2000m.org	ASD, AIA
S3000L	Logistics Support Analysis	1.1	618 / 10,4	July 1, 2014	S3000L SC	s3000l.org	ASD, AIA
S4000P	Developing and Continuously Improving Preventive Maintenance	2.0	278 / 8,5	August 1, 2018	S4000P SC	s4000p.org	ASD
S5000F	In-Service Data Feedback	1.0	694 / 17,4	September 23, 2016	S5000F Steering Committee	s5000f.org	ASD, AIA
S6000T	Training	Issue 0.1 planned by end of 2018			S6000T WG	S6000t.org	
SX000i	Guide for the use of the S-Series	1.1	174 / 5,1	July 15, 2016	SX000i WG	sx000i.org	ASD, AIA
SX001G	Glossary	1.1	98 / 0,8	August 1, 2015	DMEWG	sx000i.org	ASD, AIA
SX002D	Common Data Model	1.1	51 / 1,1	August 1, 2015	DMEWG	sx000i.org	ASD, AIA
SX003X	Interoperability Matrix					Planned: sx000i.org	
SX004G	Unified Model Language	1.0	27 / 0,6	August 31, 2016	DMEWG	sx000i.org	ASD, AIA
SX005G	XML Schema Implementation Guidance	1.0	97 / 0,8	December 31, 2017	DMEWG	sx000i.org	ASD, AIA
S1000X	Input Data Specification	Issue 0.1 planned by end of 2018			S1000D Council and SC	Planned: s1000d.org	
S2000X	Input Data Specification				S2000M SC	Planned: s2000m.org	
S3000X	Input Data Specification				S3000L SC	Planned: s3000l.org	
S4000X	Input Data Specification				S4000P SC	Planned: s4000p.org	
S5000X	Input Data Specification				S5000F SC	Planned: s5000f.org	
S6000X	Input Data Specification				S6000T WG	Planned: s1000d.org	

4.3 Interrelation of the ASD specifications

The ASD ILS Spec Council proposes the subsequent interrelation scheme of the specs:

[8] ASD (2017, 2018), ASD AIA ATA (2016), ASD AIA (2017a, 2014, 2018, 2016a, 2016b, 2015a, 2015b, 2016c, 2017b), ASD ILS Spec Council (2017)

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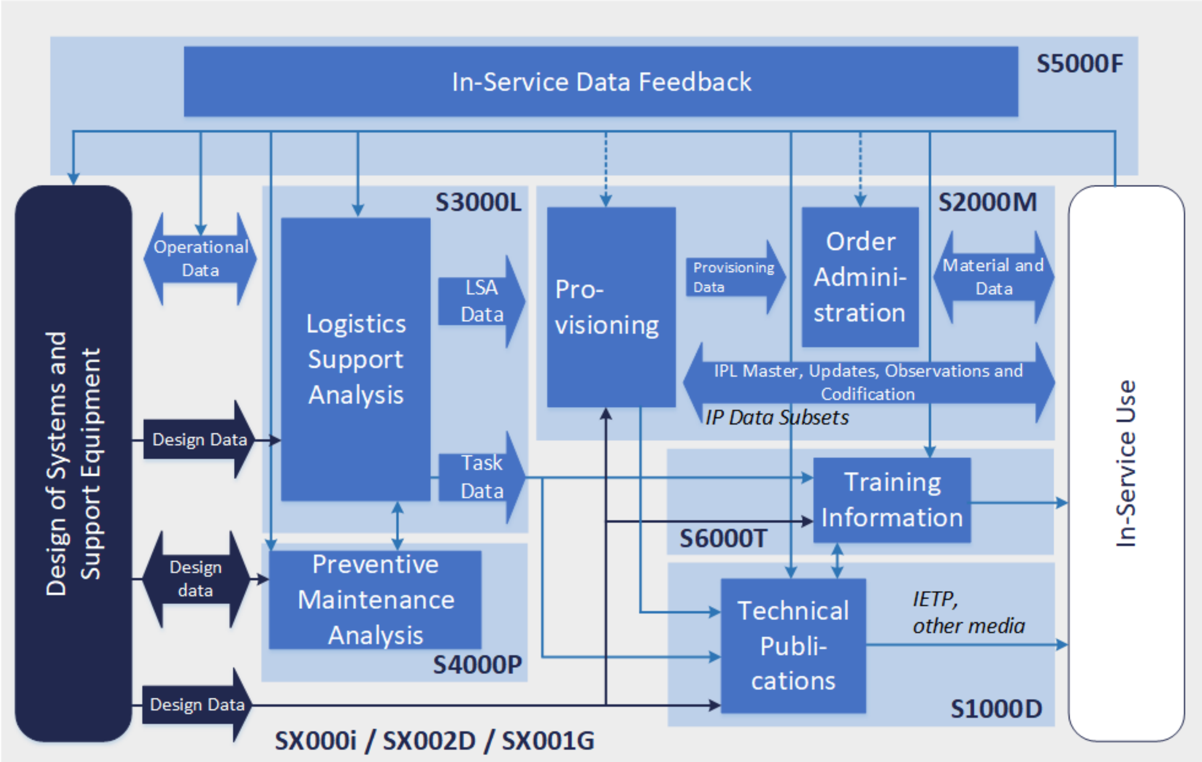

Figure 1. Interrelation Scheme of the ASD ILS Specs (ASD ILS Spec Council, 2017, p. 4)

In accordance with this scheme the start for the use of ILS specs is the system design which feeds data to S3000L, S4000L and S1000D, S2000M and S6000D indirectly through SX000i, SX002D and SX001G. S4000P only contributes to S3000L. S3000L is the interface to most of the specs and generates output forS2000M, S6000T and S1000D. Provisioning data (parts data and more) of S2000D is used for the content of technical publications (S1000D). S1000D, S2000M and S6000T support in-service directly. S5000F is used for data feedback from the in-service phase to all specs and the system design. ASD-STE 100 supports S1000D and other specs through its set of (language) rules and defined terms.

5 DISCUSSION: IS THE ILS SUITE READY FOR A&D SYSTEMS

The ASD ILS Suite follows the groundwork of other standards in ILS (cf. 2).
Firstly, for ASD, ILS is "… the management and technical process through which the logistics activities (eg. Supportability and logistics support considerations of material solutions -hardware or software-) and elements of logistics support are planned, acquired, implemented, tested and provided in a timely and cost-effective manner" (ASD AIA, 2016b, ch. 2 p. 5). ASD provides one more definition of ILS but with the same meaning as the other definitions of ILS (cf. 2).
Secondly, the purpose of ILS is the development of a support solution and optimization of supportability and life cycle cost, respectively the proper balance of cost effectiveness and system effectiveness (ASD AIA, 2016b, ch. 2 p. 5, 8). This corresponds to ILS definitions of ASD and of other standards (cf. 2).
Thirdly, the phases of the ILS Suite are preparation, development, production, in-service and disposal (ASD AIA, 2016b, ch. 2 p. 6 f.). A detailed list of the actions for every phase and a comparison of the different phases from other standards is contained in SX000i (ch. 2 p. 6 f., ch. 6 p. 3 ff.). Despite minor differences to other standards, the parity is clearly demonstrated (ASD AIA, 2016b, ch. 6 p. 3 ff.).
Fourthly, ASD ILS Suite requires an ILS plan (ASD AIA, 2016b, ch. 2 p. 38, ch. 3 p. 37, 51 ff., ch. 5 p. 4). Then, the starting point for the analyses of support activities is the LSA with the LSA programme plan (ASD AIA, 2014, ch. 2 p. 6 ff.; cf. 4.3). The definition of LSA matches with those of the standards above (ASD AIA, 2014, ch. 2 p. 3; ASD AIA, 2014, ch. 1.3 p. 3). For the record of LSA results, ASD uses a more contemporary means, the LSA database (ASD AIA, 2016b, ch. 2 p. 38 ff., ch. 5 p. 4).
Fifthly, the fields covered by the ILS Suite and the tasks of the LSA correspond to other standards (cf. ASD, 2017; ASD AIA ATA, 2016; ASD AIA, 2017a, 2014, 2018, 2016a; cf. 2).
Altogether, the ASD ILS Suite complies with the basics of ILS in preceding standards.

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For further discussion the produced outcomes of the analysis can be clustered into four segments without claiming to be complete:

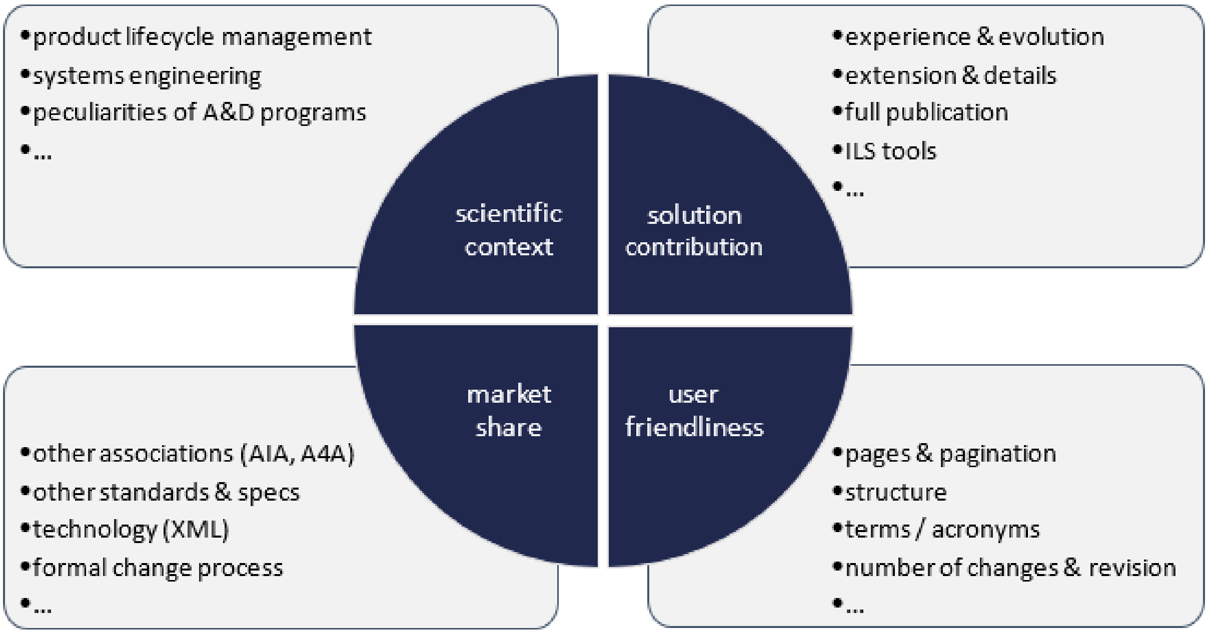

Figure 2. Considerations of ASD ILS Suite Readiness Analysis

The first segment relates to the actual (scientific) context of ILS.

The context in engineering with regard to the in-service phase of systems is dominated by product life cycle management (PLM) and systems engineering (SE).

PLM dates back to the 1980s (Eigner and Stelzer, 2009). The roots of SE go back to the 1940s (Brusa, Calà and Ferretto, 2018). PLM and ILS appeared at approximately the same time, while SE has been around for over thirty more years.

PLM can be described as the business activities which manage a company's products from the idea throughout the entire life cycle to their disposal (Stark, 2018). PLM was developed as a response to the increasing business complexity and product variety which companies started to face (Feldhusen and Gebhardt, 2008). SE is an interdisciplinary approach and means for the realisation of successful systems (INCOSE, 2013). With the ILS definitions from 2. some overlapping of ILS, PLM and SE can be seen. Moreover, ILS is an integral part of SE as ILS and SE have interfaces between SE processes and ILS tasks (ASD AIA, 2016b ch. 2 p. 6 ff., ch. 5 p. 8).

The benefits (or targets) of the application of PLM are revenue increase, cost reduction, time reduction, quality improvement and seizing opportunities (Stark, 2018). The aim of SE is the optimization of a solution to a complete problem (cf. Hitchins, 2007). Also, the purpose of ILS, as proposed by ASD but also the definitions of ILS in other standards, fits well to the targets of PLM and SE (see above).

All three areas apply a life cycle approach. For PLM and SE, classical technical product design and development tasks are elevated in importance to appear as (additional) phases within the life cycle (Eigner and Stelzer, 2009; NASA, 2016; Hitchins, 2007; Kossiakoff *et al*., 2011; Brusa, Calà and Ferretto, 2018). This implies the life cycle is dominated by engineering. Such weighting is neither representative in terms of time, nor effort, in comparison to the other phases of the life cycle (cf. ASD AIA, 2016b ch. 2 p. 6 f., ch. 6 p. 3 ff.).

In spite of this, it turns out ILS, PLM and SE have commonalities and synergies as briefly demonstrated.

The field of A&D has some major differences compared to other industries. For example, with automotive customers (car owners), they might not perform maintenance, repair and overhaul (MRO) of the vehicle themselves and go instead to a (manufacturer's) garage, which leaves the in-service support almost entirely on the side of the manufacturer. In most cases of A&D, this is different (cf. Hinsch, 2018; N.N., 2017). From large airlines to small touristic companies or sports clubs, MRO activities might be performed in-house.

That creates certain challenges for the operator (customer or user). Technical human resources need to be trained, certified and planned in accordance with operation schedules. The technical documentation for MRO has to be kept up to date. Standard and non-standard parts have to be readily available for

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preventive and ideally also for corrective maintenance. Furthermore, facilities and (special) tooling, including ground support equipment, have to be available when needed. Then, this all has to meet high quality standards and stringent aviation regulations. (Hinsch, 2018; N.N., 2017)
In general, the number of parts correlates with the complexity (or size) of the system (e.g. about 700,000 for a plane (Mas *et al*., 2015)). Thus, the probability that such a system suffers from one or many possible drawbacks for the described activities should not be underestimated. The long life cycle (Mas *et al*., 2015) induces a higher probability for these issues, resulting in non-operative systems.
PLM and SE do not directly address these particular A&D in-service issues. For example, PLM and SE do not focus on training (of technical personnel) at all (cf. Eigner and Stelzer, 2009; Brusa, Calà and Ferretto; 2018). As a consequence, ILS might just have been a logical step to close the gaps in A&D that PLM and SE did and do not fill.
The second segment comprises the contributions of ILS to the support of the in-service of systems.
ASD-STE100, S1000D and S2000M have been in place for decades. This has led to the considerable gain in experience and consequent evolution through feedback which is visible through higher issue numbers. Later introduced subjects show the same advancement, e.g. in S2000M the chapter on repair administration was introduced with Issue 3.0 and moved to a sub-chapter until Issue 6.1. That specs evolve is shown through the number of pages (e.g. S2000M: 1,739 pages in Issue 2.1; 2,974 pages in Issue 3.0; 2,146 pages in Issue 4.0; 844 pages in Issue 6.1). While Issue 6.1 has far fewer pages, there has been no loss in quality of the information contained within it. S3000L, S4000P andS5000F have been published in recent years and S6000T has not yet been released. Their relevant communities have no significant experience to make reliable statements on the quality or content (N.N., 2017).
The ILS specs are broad-ranging, but go down to single data elements. By this, the specs are applicable to very different systems. Hence, a guidance document for tailoring of processes and (data) elements must be compiled in the beginning as SX0001i, S2000M and S4000P propose, and S3000L indicates.
Despite all efforts, the ILS Suite is not yet complete. Thus, it is not (fully) useable as a framework. This explains a missing IT tool which supports all disciplines of the ILS Suite. The ILS Suite contains a glossary, a common data model, the explanation for the use of the Unified Modelling Language (UML), a schema implementation guide for Extensible Markup Language (XML), and the planned compatibility matrix (ASD AIA, 2016b, 2015a, 2015b, 2016c, 2017b: ASD ILS Spec Council, 2017). These are good conditions for the development of an IT tool.
The third segment deals with aspects of the market share of the ASD ILS Suite.
ASD represents a strong industry where revenue and employment are concerned (cf. 4.1) having also joined forces with AIA and A4A to produce a number of specs (cf. 4.2). Consequently, the joined specs are recognized in two of the most important A&D markets, the USA and Europe. Worldwide, there is neither a broader set of ILS specs nor ILS standards, nor one which is recognised in larger A&D markets. Other comparable standards are national-only (cf. 1). Besides, some specs of the ASD ILS Suite are being used by A&D programmes, e.g. TIGER, NH-90, A4000M (ASD AIA, 2014; [9]). Additionally, the specs of the ASD ILS Suite are not stand-alone but interrelated and come with a common data model, etc. (see above). All these are arguments to further increase the distribution of the ILS Suite.
Another point is that feedback on the specs can be provided by everyone (ASD AIA, 2016b, ch. 4 p. 18 ff.). However, the formal feedback and change processes are onerous owing to the ASD structure (cf. 4.1). At the same time, it provides robustness for the specs as the changes can be intensively discussed in all WGs of the concerned specs. The duration to do so will cause a delay with relevant innovations and new methods. This might not turn out to be a negative as a delay also gives time for contemplation.
The decision for the technological shift from Standard Generalized Markup Language (SGML) to XML (for S1000D from Issue 1.8 to Issue 1.9, for S2000M from Issue 3 to Issue 4, all other specs started with XML) will show its strategic direction in future. There might be some good alternatives among data serialization languages like Protocol Buffers or JavaScript Object Notation (JSON) in terms of performance (Vanura and Kriz, 2018). The coupling of specs and data exchange technology creates technological barriers between the spec issues. These barriers hinder A&D programmes from upgrading the used specs without large investment in the technological shift. ASD does not impede such upgrades as it addressed the possibility (ASD AIA, 2016b, ch. 3 p. 47). Thus, the consideration of the separation of specs and data exchange technology would be desirable. A data exchange technology could be described in a separate specification as a recommendation independent of the specs.

[9] http://www.nspa.nato.int/en/organization/Logistics/LogServ/asds2000m.htm (accessed 02/12/2018).

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The last segment handles the question about the user friendliness of the ASD ILS Suite.
The high degree of granularity results in a higher number of pages. While, for example, S2000M has managed to reduce the high number of pages without impacting quality, S1000D has steadily grown to more than 3,500 pages over the years (cf. 4.2). That number of pages cannot be read within a reasonable and cost-effective time (N.N., 2017). On the contrary, ASD-STE100 cannot reduce the number of pages without reducing the content due to its dictionary-like nature. S3000L, S4000P and S5000F have a reasonable number of pages for now (cf. 4.2).
A single document per spec instead of a data modules (DMs) structure would resolve a few issues. Firstly, the number of pages would decrease. Secondly, the issue with pagination would disappear. Currently every DM restarts pagination which impedes navigation and referencing for unfamiliar readers (N.N., 2017). Thirdly, the table of content, list of tables and list of figures would be in one place and not distributed throughout a spec (which is at the beginning of every DM, see S1000D, SX000i, etc.).
Merging some of the specs could create a better overview and a leaner ILS Suite. As a proposal, the merger of the complementary specs SX000i, SX001G, SX002D, SX004G, SX005G under responsibility of DMEWG could be an improvement. The planned input data specs (S1000X, S2000X, S3000X, S4000X, S5000X, S6000X) could be united with their original spec or in one sperate spec for input data.
A few of the terms and acronyms still vary across specs. A coherent naming convention in all new specs is ensured with SX002D. Published specs cannot now be amended, though the planned interoperability matrix (SX003G) can reveal possible spec (and release) combinations. (ASD ILS Spec Council, 2017)
The frequency of changes for the entire ASD ILS Suite would then ideally become stable with longer periods between the issue of new releases, especially for big changes like the introduction of data serialisation languages. The current problem is that not all issues are interoperable with all other specs. The planned revision in 2021 can be a first step to achieve a resilient interoperability in a stable state (ASD ILS Spec Council, 2018).

6 SUMMARY & OUTLINE

This paper presented the results of a critical review on the readiness of ILS Suite in A&D programmes.
The suite was compared with groundwork in ILS, and with PLM and SE. It could be shown that it satisfies the demand in A&D for engineering with regard to in-service activities on the customer side. Also, the ILS Suite has been recognised in the largest A&D markets. However, there are pitfalls, such as lack of user friendliness, a missing IT tool and in the coupling of specs and data-exchange technology.
In conclusion, the ASD ILS Suite it is the best set of specifications (or framework) for ILS worldwide, although some parts are not entirely ready for use.
Possibilities for future research can be found in the closer investigation of ILS, PLM and SE. All three fields are connected. However, throughout the work for this paper is seemed there are undiscovered synergies and potentially a large benefit from the combination of PLM, SE and ILS.
Further research can also be conducted on the question of how the ILS Suite performs in use (e.g. case study). Because the ILS Suite is not yet fully published and the development of an IT tool for the entire ASD ILS Suite will need additional time, such research might have to wait.

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