

PAS 280:2018

Through-life engineering services – Adding business value through a common framework – Guide



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Foreword

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Use of this document

As a guide, this PAS takes the form of guidance and recommendations. It should not be quoted as if it were a specification or a code of practice and claims of compliance cannot be made to it.

Presentational conventions

The guidance in this standard is presented in roman (i.e. upright) type. Any recommendations are expressed in sentences in which the principal auxiliary verb is "should".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Where words have alternative spellings, the preferred spelling of the Shorter Oxford English Dictionary is used (e.g. "organization" rather than "organisation").

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This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a PAS cannot confer immunity from legal obligations.

0 Introduction

0.1 What was the motivation for PAS 280?

Through-life engineering services (TES) are a set of capabilities, techniques, business thinking and network behaviours that, when applied to major assets, optimizes their value and cost (e.g. keeping major assets working better, for longer, more economically). Major assets are generally understood to comprise complex engineered products, systems or systems-of-systems with an overall life measured in decades (e.g. 10 - 100+ years) and a need for significant in-use support investment.

The motivation for publishing this PAS is to develop the opportunities for using TES within the UK to improve the capability and productivity of the UK industry base relative to international competition. In some sectors, UK manufacturers have already achieved global leadership by showing that replacing the major asset ownership model with a service-based model allows the link between profit and major asset up-time, reliability, and longevity to be explicit. This in turn drives productivity and exports.

The PAS also offers guidance to leaders in UK industry that may enable manufacturing and solution providers in all sectors to win business, gain market share, generate revenue, and earn profits from the application of TES. Given that research has demonstrated the benefits that TES derives from supply chain co-ordination, this guidance is offered to leaders of companies on every scale from multinational to small and medium-sized enterprises (SME).

The PAS does not, however, seek to duplicate or restructure existing standards. Its purpose is to capture the experience of TES in diverse sectors of industry, together with recent academic research, to establish a common vocabulary and framework for the application of TES.

Examples of sectors that are reliant on the availability of major assets include energy (e.g. nuclear, oil & gas, hydro), transport (e.g. air, auto, rail, sea, and space), manufacturing, the built environment and national infrastructure.

TES offers several benefits including value to major asset owners and users, delivering more value output per unit of cost input, whilst offering TES providers additional and differentiating revenue opportunities.

Optimized value may be measured in terms of the functionality, performance, reliability and availability of the major asset. Optimized cost may be measured in terms of expenditure necessary to sustain useful output, for example as may be required to operate, maintain, and repair the major asset.

Other benefits of TES are better responsiveness to changing operational needs, improved major asset management efficiency, and the opportunity to exploit evolving capabilities in digitally-enabled services. TES could be particularly useful for those major assets where lack of availability has a high impact, or the costs of keeping them available are high relative to the initial acquisition cost.

0.2 Scale of the economic opportunity

At the UK national level the scale of the opportunity for TES in terms of gross value added (GVA) is indicated from analysis done by the EPSRC TES Centre in 2016.¹⁾ The research draws on the list of sectors used by the UK Technology Strategy Board in their review of the 2012 high value manufacturing landscape including energy, transport and the built environment.²⁾

This list of sectors was divided into two groups and predictions for the GVA to the UK economy resulting from the diffusion of TES across the UK economy by 2025 are given in Table 1. The estimate of the potential economic contribution of TES to the UK economy is significant even if the lowest bounded estimates (£31.4 billion) are taken.

On a global level the UK has particular opportunities in specific sectors where a leading TES position has already been established, e.g. aerospace, defence, rail and information and communications technologies (ICT).¹⁾

¹⁾ Further information on this analysis is available from: www.through-life-engineering-services.org/downloads/TES-Final-Report-2016.pdf [1].

²⁾ Further information on the Technology Strategy Board review is available from: https://hvm.catapult.org.uk/wp-content/uploads/2015/08/tsb_ifm_highvaluemanufacturingt12_009_final.pdf [2].

Table 1 – TES influence on GVA at 2012 economics

Sectors Grouping	Lower Bound Estimate		Upper Bound Estimate	
	GVA (£ billion)	% of total UK GVA	GVA (£ billion)	% of total UK GVA
Maker	15.4	1	64	4.0
User	16.0	1	120	7.3

NOTE The terms “maker” and “user” sector groups are defined within the Technology Strategy Board research from which Table 1 is derived but these terms are not otherwise used in the PAS.

0.3 Key drivers and challenges for TES

TES is still a new concept in many industries, and particularly with SMEs. There is a need to build awareness throughout the supply chain of TES solutions, a common language and the benefits these solutions can offer organizations and their stakeholders. TES requires a shift in thought leadership and business approach if industry is to respond to the changing needs of their customers.

The UK civil aerospace sector is one example of an industrial sector that has responded successfully to the TES opportunity. This leading position has evolved from the product-service thinking of the 1990s into cutting-edge business models that deliver customer value throughout the product lifecycle in an integrated and holistic manner. These new business models contract for “outcome” not “activity”, for example where users pay fixed costs per hour of use rather than variable and unpredictable costs for specific maintenance and support activities when they are required (see Table 2).³⁾

Table 2 – Key drivers for TES capability improvement

Ref	Drivers	Elaboration
1	Customer demand (where the customer is understood to be the owner or user of the major asset to which TES is being applied)	- Customers moving from procuring major assets to through-life services. - Customers demanding improved equipment reliability and availability at lower cost. - Customer business models moving to lower cost and increased outsourcing (except for core operational functions); increasing complexity of major assets might challenge the customer’s ability to invest in skills, capabilities, process and facilities to maintain products. - Customers require clear and manageable through-life costs.
2	Opportunity to sustain / increase revenue	- UK industry is seeking to secure and grow revenues and profitability. - Providing advanced services smooths out revenues and mitigates impact of macro-economic cycle on product sales and developments.
3	Increasing competitiveness	- Ultimately, the end user benefits from higher value and lower cost achieved by the major asset. The improved capability of UK industry in delivering these benefits improves its international competitiveness and helps to defend the domestic market against lower cost imports. - Through-life services offer a means for UK industry to gain market share based on proprietary product knowledge and expertise.
4	Availability of enabling technologies	- Advanced servitized business models require connected, data-centric technology, autonomy technology for self-diagnosis and services. Manufacturing often refers to these technologies as Industry 4.0. - Investment in smart technologies and capabilities is required to mitigate risks of sub-optimal product performance in-service and to ensure product availability.
5	Gather and exploit through-life data	- Inform continuous improvement in the quality of through-life services during the lifetime of existing major assets, e.g. by increase in value and reduction in cost. - Inform the design of the next iteration of both the major asset itself and its support solution based on an understanding of how the current iteration is performing.

³⁾ For more information see: Through-life Engineering Services Technology Strategy for the UK Aerospace Sector [3].

Research has shown however, that some other UK industry sectors are missing this long term view of TES benefits, e.g. healthcare, renewable energy, industrial infrastructure and biotechnology, as well as emerging sectors such as bio renewables.¹⁾ Some of the specific

challenges for adopting TES have been identified by the ATI³⁾ and are shown in Table 3; these generally apply across all industry sectors. This research has helped form the approach to the scope and content for this PAS.

Table 3 – Key challenges for TES capability improvement

Ref	Drivers	Elaboration
1	Embedded product / service culture	- Traditional manufacturers have a strong technology orientation which might inhibit the transformation toward a service-oriented culture. - In traditional business models the technical and financial uncertainties associated with achieving the required reliability and availability are largely carried by the customer. Manufacturers aspiring to become TES providers need to take on a share of these uncertainties. - Owners or end users increasingly benefit from an open market in which the TES provider is not necessarily the original manufacture. The manufacturer may need to disclose a minimum set of technical information to allow third party bids for TES (e.g. as may be driven by future legislation, regulation, or contract conditions invoked by TES-aware customers).
2	Delivery of integrated solutions	- Manufacturers' product-centric orientation needs to be replaced with service-centric across all business functions. - Lack of organizational responsiveness can inhibit provision of integrated solution. - Multiple touch points are required on interface between provider and customer. Touch points include technical and human considerations.
3	Internal processes and capabilities	- Alignment of product and service design processes is required for design of an integrated solution and effective response to customer needs with agility. - Performance metrics that measure an organization's collective ability to deliver integrated solutions. - Manufacturing-based metrics alone are not suitable for measuring product/service provision. - Ability to predict the cost / price of TES to a stated level of confidence, and with far enough look-ahead, to sensibly inform business planning and contractual arrangements.
4	Strategic alignment	- Internal cooperation, common language, a framework for discussion and alignment of mind sets is required within each of the stakeholder organizations to accelerate collective transformation efforts. - Transformation efforts need to be similarly accelerated across wider networks and value chains spanning multiple stakeholders.
5	Supplier relationships	- Transactional relationships prevent the provider's external network from effectively supporting integrated solutions and exploration of potential to share risks and opportunities (e.g. technical, financial, operational and business). - Changes in relationships between the product / service provider and its' customers are not reflected in the relationships with the provider's suppliers.

0.4 Application and implementation

The purpose of this PAS is to help the stakeholders in the manufacture and through-life support of a major asset to maximize value, minimize cost, and achieve an optimized product and support solution which has predictable technical, financial, operational and business outcomes. Stakeholder groups may include the:

- manufacturer of the major asset (including partners and wider supply chain);
- support services provider (including partners and wider supply chain);
- owner of the major asset; and
- end users of the major asset.

NOTE 1 The support services provider may comprise either the manufacturer of the major asset or a third party company. The owner of the major asset and/or end users might achieve the best outcome by inviting proposals from the widest possible range of providers. The choice of provider involves consideration of a number of technical, financial and business trade-offs and, for a long-life major asset the choice of provider may be re-visited at intervals.

NOTE 2 The supply chains identified above may comprise companies of all sizes down to SMEs. For a long-life major asset the constituency of the supply chains change over time as a result of; proactive changes to improve value and cost, and reactive changes to external events (e.g. mergers and acquisitions, resolution of obsolescence). The terms “manufacturer” and “provider” in this PAS embody the partners and wider supply chain of these actors.

NOTE 3 The term “customer” in this PAS includes the owner and end users of the major asset.

0.5 Intended audience

The PAS is focused on the leadership community within UK industrial companies participating in the stakeholder groups listed in 0.4. This includes companies at all levels of the supply chain from multinational companies through to SMEs.

In particular, the leadership community in the participating companies is in a position to influence UK national prosperity by advocating and sponsoring an improved capability in TES. This PAS provides guidelines to enable and support this objective expressed in terms of a framework and vocabulary.

0.6 Other relevant standards

Table 4 outlines key standards that support this PAS and the delivery of a TES solution, this list is not meant to be exhaustive.

Table 4 – PAS 280 and related standards

Identifier	Title
BS EN ISO 9001	Quality management systems – Requirements
BS EN 62402	Obsolescence management – Application guide
BS ISO 44001	Collaborative business relationship management systems – Requirements and framework
BS ISO 55000	Asset management – Overview, principles and terminology
BS ISO/IEC/ IEE 15288	Systems and software engineering – System life cycle processes
ASD S5000F	International specification for in-service data feedback
ILSDEF STAN 00-600	Integrated logistics support for MOD projects

1 Scope

The PAS outlines the activities and capabilities necessary to maximize value for all stakeholders over a major asset's lifecycle.

It gives guidance on a common framework for through-life engineering services (TES). It includes planning for the full lifecycle of a major asset in order to meet the customer requirements. This PAS addresses TES for a major asset across the full supply, operate and support chain (whole-life from concept to disposal) and across the system (end-to-end from customers or service users through tier one suppliers to SMEs, considering products and services offered).

The framework is designed to enable collaboration through a common vocabulary across the system to deliver the customer requirements of major assets.

This PAS is for use by both providers and users of major assets, with particular emphasis on thought-leaders who might influence UK national prosperity.

NOTE 1 *This PAS may be read in conjunction with BS ISO 55000:2014 and other relevant standards which provide guidance on the business case and lifecycle management of long-life major assets at the level of the business unit. PAS 280 is intended to consider the integration of the business case and business and engineering operations at the level of the enterprise or consortium to the benefit of all participants.*

NOTE 2 *This PAS encourages collaboration between multiple organizations with a mutual interest in TES. It is assumed that each organization respects the intellectual property rights of others, and that each enters into appropriate agreements where data, information or knowledge needs to be exchanged.*

2 Terms, definitions and abbreviations

2.1 Terms and definitions

For the purposes of this PAS, the following terms and definitions apply.

2.1.1 asset

item, thing or entity that has potential or actual value to an organization

NOTE 1 Value can be tangible or intangible, financial or non-financial, and includes consideration of risks and liabilities. It can be positive or negative at different stages of the asset life.

NOTE 2 Physical assets usually refer to equipment, inventory and properties owned by the organization. Physical assets are the opposite of intangible assets, which are non-physical assets such as leases, brands, digital assets, use rights, licences, intellectual property rights, reputation or agreements.

NOTE 3 A grouping of assets referred to as an asset system could also be considered as an asset.

[SOURCE: BS ISO 55000:2014, 3.2.1]

2.1.2 asset value

stake an asset holds in an enterprise or economy based on functionality, availability, utilization and revenue versus cost

2.1.3 availability

serviceable major asset(s) that exist in the right quantity, the right location and at the right time to be able to support the customer's requirements

2.1.4 capability

major asset when operating is able to achieve its design intent and the customer requirements

NOTE This includes both an instantaneous level of functionality and a minimum duration of functionality.

2.1.5 configuration item

sub-system or component of a system that is treated as a self-contained unit for the purposes of the through-life support of a major asset

NOTE For the purposes of identification and change control of replaceable items and configuration control of the overarching set.

2.1.6 continuous improvement

ongoing effort to improve products, services or processes

NOTE These efforts can seek "incremental" improvement over time or "breakthrough" improvement all at once.

{SOURCE: American Society for Quality [4]}

2.1.7 cost

measure of expenditure necessary to sustain useful output from a major asset

NOTE For example, cost that might be required to operate, maintain, repair and adapt the major asset.

2.1.8 customer

single organization or consortium of organizations which owns or uses the major asset to which TES is applied

NOTE The customer is usually under a contractual agreement with a provider.

2.1.9 customer requirement

required optimum level of operational functionality, for a minimum period of time, to achieve the required customer outcome

NOTE The required customer outcome might be expressed in several ways, for example:

- a) a period of 24 hours of machine tool operation without stoppage;
- b) a series of six flights over three days for a civil aircraft leaving its base of operation on a round the world flight circuit; or
- c) deployment of three weeks for an armoured personnel carrier without maintenance.

2.1.10 functionality

measure of whether a major asset is capable of meeting the customer requirement at a given point in time

NOTE Functionality is typically described in terms of a set of inputs to the major asset, the behaviour, and the outputs and defines what a system is supposed to accomplish.

2.1.11 health and usage monitoring system

application of physical sensors and software techniques to derive knowledge of the current condition of a major asset in-service

NOTE For example, to provide early detection of progressive deterioration so that rectification can be achieved before there is major impact on major asset safety, functionality, or performance.

2.1.12 industry 4.0

trend towards automation and data exchange in manufacturing technologies

NOTE For example cyber-physical systems, the Internet of Things, cloud computing and cognitive computing, which together with other technologies, can create what has been called a “smart factory”. The term was publicly introduced in 2011 as “Industrie 4.0” in the course of an initiative to enhance the German competitiveness in the manufacturing industry.

2.1.13 major asset

asset with highly engineered complexity, overall life measured in decades, and a need for significant in-use support

NOTE For example aircraft, trains, ships, vehicles, power-plants, machine tools, buildings and national infrastructure.

2.1.14 obsolescence

loss of supply chain options for replacement of configuration items prior to the end of their required operational period

NOTE For example the inability to source spare components, such as electronics, when technology progress replaces them with new standards.

2.1.15 provider

single organization or consortium of organizations with responsibility for provision of TES, usually under a contractual agreement with a customer

2.1.16 reliability

probability that the major asset remains serviceable throughout the duration of the customer’s requirement

NOTE The determination of whether a major asset is serviceable is specific to its application and whether it delivers the required functionality and performance on demand. This determination is typically informed by qualification activities prior to first entry to service as well as monitoring in service.

2.1.17 servitization

adding value by adding services

NOTE There are many other definitions available as a result of the ongoing evolution of the subject.

2.1.17 small and medium-sized enterprise

non-subsidiary, independent organizations which employ fewer than a given number of employees

NOTE The most frequent upper limit designating an SME is 250 employees, as in the European Union.

2.1.18 through-life engineering services

set of capabilities, techniques and behaviours that are applied to major assets over their entire lifecycle to achieve optimum value in use at entry into service and through life

2.1.19 utilization

application of the available major assets to achieve the customer’s desired outcomes

2.1.20 validation

assurance that a product, service, or system meets the needs of the customer and other identified stakeholders

2.1.21 value

useful benefit delivered from major assets in terms of both tangible functions and intangible functions

NOTE 1 Tangible functions are the most obvious measures of value, e.g. the visible outputs or effects delivered by the major asset.

NOTE 2 Intangible functions such as reliability, recoverability, maintainability might also be considered as having value. For example, the reliability of an emergency rescue vehicle provides assurance of readiness even if never deployed.

NOTE 3 The classification of functions as being tangible or intangible may sometimes depend on the industry or business context. For example, availability is often treated as an intangible yet may have a direct impact on the economic viability (e.g. power generation, transport systems, and other major assets reliant on continuous revenue).

2.1.22 verification

evaluation of whether or not a product, service, or system complies with a regulation, requirement, specification or design intent

2.2 Abbreviations

For the purposes of this PAS, the following abbreviations apply.

CI	configuration item
GDPR	general data protection regulations
GVA	gross value added
HUMS	health and usage monitoring system
ITAR	international traffic in arms regulations
KPI	key performance indicator
PAS	Publicly Available Specification
SME	small and medium-sized enterprise
SLA	service level agreement
TES	through-life engineering services