Chapter 10
A Framework for Service Information Requirements

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Abstract The increase in the percentage of revenue gained by nations as a result of growth in the service sector has been accompanied by the use of performance-based contracts to support such services. These performance-based contracts tend to be long-term in nature and often involve multiple parties in their service operation. In order to support such a service operation, information is required for its design, delivery and evaluation. This chapter provides a review of models and frameworks for the design and development of services. It focuses on providing details of a framework which has been developed for the determination of, specifically, service information requirements in order to design, deliver and evaluate services provided against engineering assets. It provides some general analyses of problems encountered within service providing organisations, and highlights areas of good practice. Further areas of application for the proposed framework are also presented.

10.1 Introduction

The proportion of revenue derived from different sectors of the economy has changed. In the UK, service, industry and agriculture account for 76, 23 and 1% of the nation's Gross Domestic Product (GDP), respectively (The World Factbook

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2008). This growth in the UK's service sector has been steady from around 55% in the 1970s (OECD 1996). The growth in the provision of services may be from traditional services, such as education and healthcare, through to those provided in an industrial context around complex engineering assets. While the split is not indicated by these statistics, they reinforce an apparent trend in the servitization of engineering organisations. Research by Neely indicates that the boundaries between manufacturing and service firms are breaking down across the globe. From a study of publicly listed engineering companies from around the world, 30% had been deemed to have servitized and 70% had remained as pure manufacturing firms (Neely 2009). Therefore, in consideration of the figures for the GDP above, a number of the service providing firms may potentially be derived from the industrial or service categories.

Alongside this rise in services there has been an increase in the use of contracts to support the delivery of such services. A number of types of contracts are used in such contexts ranging from a traditional context where these were generated on a case-by-case basis to a situation where contracts are now performance-based agreements, often involving multiple parties. Typically, four types of contracts are referred to within this chapter, namely, spares and repairs, spares inclusive, availability and capability. In the context of a spares and repairs (or discrete) contract, the industry is contracted for the supply of assets while the customer is responsible for the repair and overhaul of assets. Spares inclusive are similar to spares and repairs contracts in terms of the supply of parts, while joint customer–supplier teams undertake the maintenance and overhaul and share the risks. However, responsibility for the equipment remains with the customer (National Audit Office 2007). In the context of an availability contract the risk and responsibility is, again, shared between the customer and the supplier. The supplier is often the equipment design authority while both customer and supplier commit to contractual performance guarantees, or Service Level Agreements (SLAs) in order to enable a fit-for-purpose asset (National Audit Office 2007). The supplier/service provider guarantees availability of assets, at a pre-determined level, throughout the lifetime of the product (Cohen 2006; Kim et al. 2007). These agreements may last from months to tens of years (Gruneberg et al. 2007) and, as such, the relationship between the customer and supplier has lengthened. A capability contract places all risks and responsibilities on the supplier, who is responsible for providing a given capability without specification of the means by which this may happen (National Audit Office 2007).

As contracts move from traditional towards capability, the number of contracts provided by an organisation often reduces while their value increases. In addition to the financial and strategic incentives of higher revenue (Wise and Baumgartner 1999) with increased longevity, the change has also given rise to environmental benefits. This change has also impacted the nature of the risk associated with the service offering (Stremersch et al. 2001).

Information is critical to support the contract and, thereby, to furnish the service. While information about the asset location, condition and use is of importance to the service, additional information elements are needed in order to provide

the service including, for example, information about the logistics, resources and finances of the service. Information has been described as the lifeblood of the organisation, the most valuable resource in industry today, a prerequisite to invoke the service and, despite this, an undervalued resource (Court 1995). Information is central to requirements determination for products and services. Given that the fundamental task of delivering a product or service is to ensure that the final outcome matches the specification (Levitt 1972), it is of utmost importance that information requirements are determined as accurately as possible. For the purposes of this chapter, information related terms will be defined as follows:

- *Information:* a combination of fact, context, meaning and relationships (as opposed to data which may be defined as that which is known or granted without a wider sense of meaning or interpretation).
- *Service Information:* information used to make decisions and take actions in a service environment. This will include, among others, information on maintenance, operations, resource, finance and engineering.
- *Information Requirements:* information needed to make decisions and take actions in a service environment (Cuthbert 2009).

These long-term performance-based contracts which are of a multi-organisational nature require an increased level of trust, openness and sharing in order for the service to be successful. A number of frameworks have been proposed to support the design and development of services, but information is not central to these. Situated within the Core Integrative Framework (CIF) is the transformation of information in the provision of services (Ng et al. Introduction chapter). The work described within this chapter is of a framework to enable the determination of information requirements for the design, delivery and evaluation of services. The framework may also be used to determine the information transformation required as services evolve.

10.2 Background

A significant amount of research has taken place over the years in the area of information requirements. However, relatively little research has been devoted to information requirements in a service context, and hence we predominantly draw here on research in relation to engineering design and information systems development.

In the context of engineering design, information provides a key resource at all stages of the product lifecycle (Hicks et al. 2002; Court 1995, 1997; Court et al. 1997; Lowe et al. 2004). Information influences beginning-of-life design and development decisions for new products (Hicks et al. 2006), middle-of-life product maintenance and design improvements, and end-of-life disposal and recycling actions. At each stage, information about the asset configuration and use is crucial in making informed decisions.

In the context of systems development the beginning-of-life phase or the requirements phase is recognised as the most important but also seen as a major problem (Davis 1982). Developers of systems tend to have limited understanding of the nature of the information needs while users may often be unable to accurately define what information they need (Wetherbe 1991; Watson and Frolick 1993). Furthermore, requirements can often be thought of as complete and static when, in fact, they will be continually evolving and differ between system users (Court et al. 1997; Flynn and Jazi 1998; Dearden 1964; Grudnitski 1984).

In a similar way to the engineering design and information systems development contexts, information within a service context also needs to be recognised as an essential input. A key element of services is that they receive and process customer information (Wathen and Anderson 1995). When compared with a manufacturing environment, information may be said to be "the raw material of service organisations and how it is processed will have a direct bearing on their productivity" (Wathen and Anderson 1995). Its quality, quantity and the process performed upon it will have a direct impact on the quality and productivity of the output operation. Services require the involvement of the customer in order to determine and understand their requirements (Fleiss and Kleinaltenkamp 2004) and, in circumstances where the service provided supports a complex engineering asset, a large amount of information about the use, components and configuration of assets is needed. Despite this, the design and implementation of services is not a well understood process (Tax and Stuart 1997).

In service models, information is dealt with to varying degrees, often focussing across the breadth of the service or in depth on other elements of the service. A review of a selection of these is provided in order to show their contribution in relation to information requirements determination for the design, delivery and evaluation of services.

A model for the development of new services was created by Johnson et al. It shows the new service development process as a continuous cycle (Johnson et al. 2000) and highlights some of the key enablers for the process which are shown as core elements within this model. However, information is excluded as one of these core enablers.

The design and delivery of service quality which reviews the design and delivery of the service was modelled by Ramaswamy (1996). A model for the design and management of services, reviewing service design and service management as two distinct domains, was also created. The design specification, its attributes and performance standards are developed within the design stage. From this, design concepts are generated and evaluated for subsequent development. Delivery and evaluation of the service is encompassed within the service management stage. The delivery is viewed as the implementation stage while the more significant evaluation stage comprises performance measurement, assessment of satisfaction and performance improvement.

Parasuraman et al.'s service quality gap model (Fig. 10.1) highlights four main gaps in the service process:

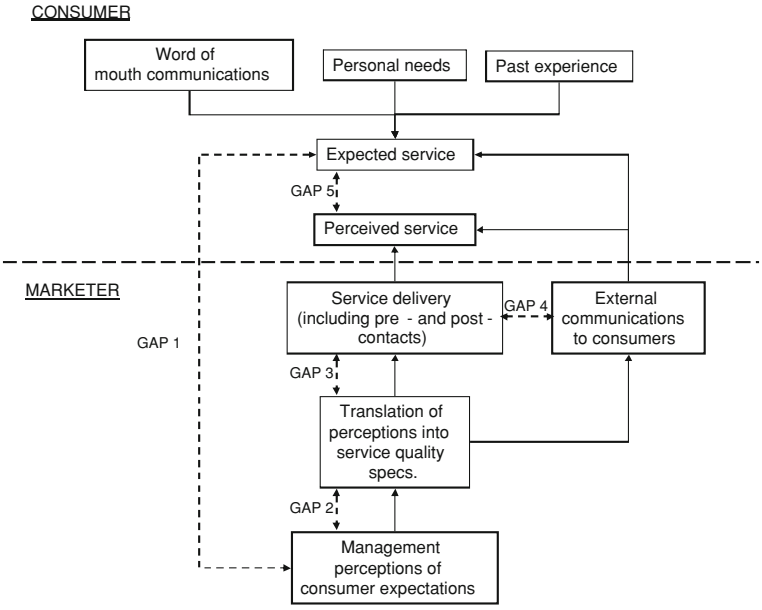

Fig. 10.1 Service quality model (Parasuraman et al. 1985)

- the gap between customer expectations of the service and the company understanding of those expectations,
- the gap between the company understanding of customer expectations and the development of customer-driven service designs and standards,
- the gap between the development of customer-driven service standards and the actual service performance by company employees, and,
- the gap between the service delivery and the service provider's external communications or what the supplier advertises to a third party that it is providing which may raise the customer's expectations are highlighted (Parasuraman et al. 1985; Zeithaml and Bitner 2000).

Sakao and Shimomura developed Service Explorer, a computer aided design (CAD) tool consisting of four sub-models. These sub-models are termed the flow, scope, view and scenario models and, respectively, represent the different players in the service supply network, the boundaries of the service network, the variables which impact the customer experience and the service receivers and their behaviours in receiving the service (Sakao and Shimomura 2007). This model does not deal with information requirements throughout the service.

Johnston and Clark describe a model which shows services as consisting of five main elements: the idea, experience, outcome, operation and value (Johnston and Clark 2005). This model provides a useful framework from which information may be highlighted or specified, but does not explicitly refer to information.

Industrial tools and models which are available tend to focus on the depth of information in a specific organisational function, whereas, the academic tools and models tend to focus on the breadth of service with scant consideration of information. There is a degree of overlap between areas of these frameworks in terms of the aspects of the service operation which these capture.

In most cases, the perspectives taken, the coverage provided by the framework or the enablers highlighted within the frameworks do not provide a broad information perspective across the service offering. What is evident overall is that these frameworks each deal with different issues relating to the design and modelling of service operations, covering service management, design, evaluation, quality and the enabling elements of services but without specific reference to information as one of these.

Breadth and depth of information throughout the design, delivery and evaluation of services is necessary in order that the desired service is developed by the provider, delivered to the customer and improved by the provider. Without key information throughout these stages of the process, the operation of such services to a desirable quality is likely to be challenging. With these other models in mind and their limited coverage with respect to information, an alternative framework, focussing on information requirements throughout the different stages of the service, offers real benefits which are critical to the effective design and delivery of the improved services.

10.3 A Model for Service Information

The previous section highlighted the lack of a framework to provide breadth and depth of information in a service providing environment. A framework which encompasses these requirements is proposed and described within this section (Cuthbert 2009). The evidence on which this framework is based is from close collaborations with a number of companies which have also led to a number of case studies (Cuthbert 2009).

The framework proposed in Fig. 10.2 deconstructs the service process from an information perspective. It is based on a representation of a notional four stage service supply chain. Each stage is represented by one of the four rectangles in the figure, namely, service need, service specification, service offering and service operation. These stages encompass the customer's domain (at the right hand side of Fig. 10.2) where a service need is generated. This is then jointly developed by the customer and supplier into a formal service specification. After this has been developed, the supplier progresses design of the service offering to meet the specification, and the design of the service operation to enable the service to be delivered. Traversing these service supply chain stages are underlying processes and information flows which are required to enable the service. Phase one is design information, used to develop the service and predominantly flows from the customer's domain to the supplier's domain. Phase two refers to information required

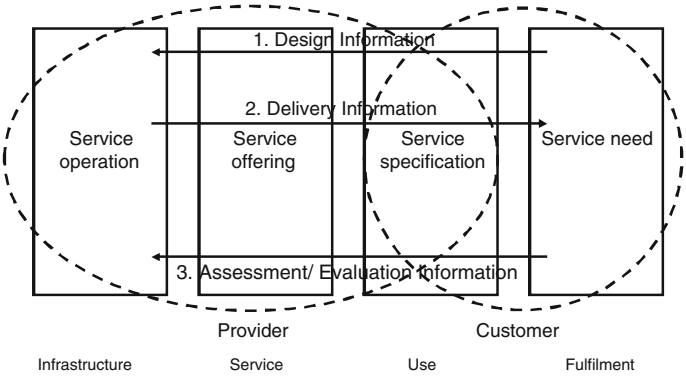

Fig. 10.2 Service information framework (developed from Cuthbert et al. 2008 by the addition of the terms infrastructure, service, use and fulfilment to correspond with the stages of the supply chain. The area within which provider and customer operate and have influence has also been updated to improve industrial relevance.)

in order to deliver and improve the user's interaction with the service. The third phase provides an indication of the performance and the effectiveness of the delivered service and a means by which the service may be measured. This may enable the provider to ensure that what is being delivered satisfies that which is required by the customer and also provides a mechanism from which improvements to the service may be made where necessary. While work on the nature of information services is evident (Berry and Parasuraman 1997; Lovelock 2001) the work reported within this chapter differentiates between information forming part, or all, of the service and information playing a role in the effective delivery of the service. This framework focuses on the latter. The role of three categories of information is considered, which form part of the overall service information requirement, namely, design, delivery and evaluation information (McFarlane et al. 2008).

The right hand side of the Service Information Framework represents the domain in which the customer has the most influence while the centre and left hand sections represent the domains in which the supplier has the most influence. Throughout the service supply chain are underlying process and information flows which correspond with information required to design, deliver and evaluate the service. The evaluation stage ensures that, as far as possible, the delivery is critiqued against the design to ensure that the customer's needs are satisfied. This ensures that the delivery is aligned with the design and the customer's need.

This framework was developed by dividing it into a three-by-four matrix as shown in Fig. 10.3. In this figure, the columns correspond with the stages of a nominal supply chain and the rows correspond with the underlying processes and information flows. This framework should be regarded as a closed loop system with feedback from the evaluation stages into both the design and delivery stages in order to constantly improve the service.

	Service Operation	Service Offering	Service Specification	Service Need
Design	4 Technical information to plan & develop the delivery of the offering	3 Technical/ architectural/ legal information to design offering	2 Information to formalise service contract	1 Conceptual information about customer requirement
Delivery	5 Technical info to run service/ infrastructure	6 System level functional information to fully supply service offering	7 Information with respect to service use	8 Information from provider enabling user to exploit service
Evaluation	12 Operational information on performance of service infrastructure and operations	11 Info relating to the effectiveness of service offering and its SLA metrics	10 Information to illustrate the perception/ expectation of the service – vs SLA	9 Information to determine fulfilment of customer need
	Infrastructure	Service	Use	Fulfilment

Fig. 10.3 Developed service information model; a three by four matrix of information types required in service development (developed from Cuthbert et al. 2008)

The framework presented in Fig. 10.2 provides a structure to inform data collection. In conducting case studies a key question is which firms, sectors and organisational characteristics would be appropriate? The criteria of this research require companies to display a core set of characteristics. This must include the provision of services against a contract monitored via some key performance indicators. Contracts should represent an increased level of risk to the organisation as their product or service offering is extended. There should also, ideally, be multiple partners involved in the provision of the service as this is likely to highlight some of the information sharing and ownership issues which the framework seeks to determine.

Before using the framework, a set of high level, generic information is gathered in relation to each of the case study organisations and the terms around the contract. The framework is then used as a guide in a semi-structured interview. Ideally, several interviews would be carried out for one particular contract to provide different perspectives of the same service and contract. The text detailed within each of the 12 boxes of this model represents a high-level generic description of the information type required at each stage. These are reviewed with the interviewees in numerical order, detailing the types of information needed within each box/stage. The information required for each box is recorded and these are reviewed to gain an understanding of which of the required information is actually available to the service provider. These are taken directly from the order and direction of the arrows, representing the underlying processes and information flows, in the original service information model of Fig. 10.2. A more detailed description of the information required in each of the twelve boxes follows.

10.3.1 Design Process

In Box 1, information is required around the service need. This is a set of requirements from the customer which may be conceptual as the customer may not fully understand what they require, despite believing that they have a clear set of requirements. Box 2 is the information required to determine the specification of the service design. This is information from Box 1 combined with other information from the supplier and other external sources which may provide a new perspective on, for example, the context of the service and how it may change in future. The information required at this stage will be formalised into a contract and subsequently signed off by both parties. Box 3 requires information around the service use to develop the service offering. This should use a full set of requirements drawn from the specification and is used to determine how the solution will look. The means by which the service will be measured needs to be designed into the process. Box 4 requires information around the infrastructure on the service operation. This is the space in which the technical solution is developed, and the hardware and software are specified. Information is required to help determine the tools, maintenance facilities, people and other resources.

10.3.2 Delivery Process

Boxes 5–8 correspond with the delivery process. For Box 5, information is required on the hardware and infrastructure issues or failures which prevent or impede the service delivery. Information on other infrastructure issues which may help with the planning of, or possibly impede the delivery of, the service is also required. For Box 6, system level functional information to supply the service is required. Information on how the service is actually delivered by the supplier is required. This may include information on the availability of the asset for maintenance to plan the delivery of the service, as well as usage of information and information on the asset relating to work carried out by the customer of Box 7 will include information with respect to the service use, information on how the assets have actually been used (against what they were specified for) and information on the actual consumption of the service (spares, hours used etc.) compared with what was specified. Box 8 requires information to enable the customer to best use/achieve fulfilment from the service. This may include information about the assets (provision of training) or information on the customer's use of the service compared with their stated requirements.

10.3.3 Evaluation Process

Boxes 9–12 correspond with the evaluation process. Box 9 requires information which evaluates the customer's fulfilment from the service delivered against the

original need stipulated by the customer. This should indicate the customer's perception of their requirements against what was received or made available to the user. Box 10 requires information which provides an evaluation of the specified service agreed between supplier and customer. This will enable an evaluation of the perception versus expectation of the formally agreed requirements and will be measured against the contractual SLAs. Box 11 measures the effectiveness of the service offering and the SLA metrics and whether the SLAs skew the service. It seeks information to determine whether the service which has been delivered is equivalent to that which was designed, based on the specification. It is also used to determine whether the service is being used fully or whether elements of the service are not being used. Box 12 seeks information to determine whether the elements of the service (infrastructure) are performing as they should be to satisfy the service design/delivery.

10.3.4 Framework Application

The framework has been applied to a range of different services provided within traditional service organisations and also for services delivered around complex engineering assets involving different contract types. It has been used to provide insights on information maturity in nine industrial Product Service Systems (PSSs) through the use of a classification approach where information was categorised as being both required and available, inconsistently available or not available but required. Figure 10.4 summarises the general state of information availability for the three scenarios (S1, S2 and S3) of the washing machine case study of Chap. 11 highlighting areas where information is consistently available, inconsistently available or unavailable. In a full application of the model, each shaded box (e.g., the design stage of the service need) would be subject to a detailed iteration to determine the availability of specific types of information within that box. Examples within the category of the design stage of the service need might include information on the systems or capabilities required of the service, the customer's budget, or the likely geographical deployment of the asset.

Overall outcomes from the nine industrial PSSs indicate some general areas of problems encountered within service providing organisations as well as areas of good practice. These are discussed in the following section.

10.4 Analysis Using the Framework

In the first instance, this framework has been applied extensively to a number of services provided both in traditional service providing sectors as well as in services provided against complex engineering assets. In each case, the type of contract against which the service was provided differed from spares and repairs, spares

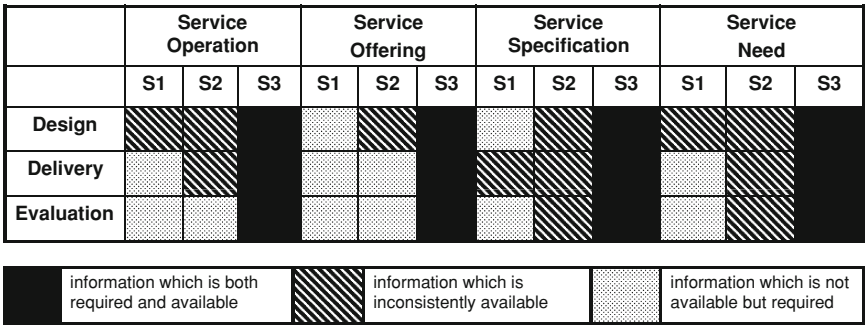

Fig. 10.4 High level example application of the service information model to the washing machine case study of Chap. 11

inclusive, availability and capability (Cuthbert 2009). The type of contract is of significance as the information required, owned and available to the customer and supplier in different contractual scenarios is likely to differ due to the differing roles and responsibilities of each party. However, the framework was predominantly used to highlight differences in the information required and available for a number of services. From this, a gap in the information which was consistently required and available could be determined. Despite a number of case studies being carried out against services with different contract types, information problems re-emerge with similar themes across the case studies, and it is these common themes which are presented within this section.

In all instances of its application, the framework showed that a limited set of information tends to be available around the customer need. This may be shown as a deficiency due to the suppliers not being thorough enough in their requirements gathering processes or attributed to the customers not always understanding their own needs of the service, or the potential of the service which could be offered. In instances where the customer has a clear definition of their needs, these may still be difficult to articulate and specify.

Applications of the framework illustrated a consistently poor level of historic information available to service providers in relation to the complex engineering asset being serviced. This was often a result of the service being passed from one provider to another, and the information which was also passed between providers to enable the service provision. With such a deficit of information, the design and delivery of the service must be based upon models and estimates, rather than more factual information. This deficiency also includes information on external factors impacting the service such as information from third party providers.

The framework is designed in such a way that the design and delivery of services should always be compared through evaluation information. A dynamic approach to this is required to ensure that the services delivered satisfy the original needs. Furthermore, in carrying out this comparison any evolving changes in the nature of the service may be highlighted by the framework. The realities of such services are that the requirements are constantly evolving as customer requirements change and

as new capabilities may be provided by suppliers. This indicates the need for a regular review of the service, which this framework may provide.

Insights were also provided by the framework into the information requirements for the different contracting arrangements of the different services. Availability contracts tended to show a better level of information at the design stage enabling a thorough understanding of customer's needs. During the delivery phase of the services, more information about the costs and requirements of the services tends to be available. In the evaluation stage, more information is available to enable analysis of services provided in order to populate performance metrics. In addition, information to forecast the likely use of assets and their failure is available.

Further to the application of the framework to understand differences in information required and available and the impact of different contract types, a number of other application areas may be considered in the areas of contracts, organisational function, sectors and projects. Firstly, the framework may be used to indicate the types of information required at different stages of new or existing systems or processes. It may also be used to enable an understanding of the gaps within existing (IT) systems, processes, information (required and available information). The framework may be used to highlight dependencies upon information shared between organisations. In such cases, weaknesses in information links/exchange between organisations and their vulnerability in terms of who owns what information may be highlighted. Finally, areas where improvement is required in terms of information may be illustrated.

10.5 Conclusions

A framework has been presented which has been used to determine information requirements for the design, delivery and evaluation of services. It has been demonstrated to provide a high level assessment of the information required for the service, and to understand the gap between this and the available information. Its application has been across a broad range of situations, including different contracts, organisational functions, projects and sectors.

This is useful in a number of situations. For organisations providing services against contracts, it may enable an understanding of the different information needs for different types of contracts and enable the organisation to upgrade its service provision, more easily, from one contract type to another.

From an organisational or functional (e.g., R&D, finance etc.) perspective, it may provide a gap analysis of information required and available in different areas of the service operation. This may enable the organisation to identify information-deficient areas within their organisation and to focus their efforts in order to improve their performance as a company and the service delivered to their customer.

For an assessment of different industries, the model may be applied to understand how advanced different sectors (e.g., Engineering (Commercial and

Defence), Information Technology, Finance, etc.) are in terms of information provision. This may enable an organisation to learn areas of good practice from a non-competing business and apply this within its own domain.

Areas where this framework has been applied successfully include cross-sector, -project and -contract scenarios. Within some of these areas, the framework could be developed in order to take the information assessment to a more detailed level.

10.6 Chapter Summary Questions

This chapter has raised a number of issues in relation to the information elements of service design, delivery and evaluation. Pertinent to this is understanding fully what information is required at each stage of the design, delivery and evaluation of the service and what information gaps are present within existing services. Of note within this work is the information required around the customer's need as well as an understanding of the information needs of the service provider. The type of contract will also impact the information availability to the service provider and present some dependencies and vulnerabilities within the information available. Some key questions are:

- How may required information be best identified, and made available within a service environment?
- What mechanisms may ensure that the customer fully understands their requirements, and the full capability on offer by the provider? How is this best articulated?
- What process may be used to ensure that the service remains dynamic and evolves with the customer's needs and the supplier's capabilities?

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