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Modern agile enterprise operating environment is a distributed network of uniquely identifiable independent and inter-dependent adaptive service systems that are hosted on geographically distributed facilities. A facility is a built environment that provides a place for hosting on-site, off-site, cloud and non-cloud service systems and factories. These adaptive service systems and factories can be provided by the same or different adaptive service systems and factories. Enterprise service systems interacting with each other could be hosted, mirrored or replicated on the same or different facility. Enterprises need to understand and design their facility architecture, as a part of their overall enterprise architecture. Facility architecture is important for architecting and supporting other domain architectures. However, the existing mainstream enterprise architecture frameworks lack the support for developing facility architecture though they do discuss technology infrastructure architecture, which is different from the holistic facility architecture. The Gill Framework provides the support for developing the facility architecture. This framework can be used with available tools for developing facility architecture within the overall context of enterprise architecture.

This white paper explains the key components of the facility architecture domain that would help the architects, analysts and leaders in understanding its applicability and integration with other enterprise architecture domain architectures. Firstly, it discusses the need for a new facility architecture domain. Secondly, it discusses The Gill Framework

and defines the novel facility architecture. Finally, it discusses the facility architecture components and concludes with a short discussion about how the facility architecture can be used within the overall context of enterprise architecture.

Need for a Facility Architecture

Modern agile enterprise is a geographically distributed network of on-site and off-site, on-shore and off-shore, independent and inter-dependent human, non-human and IT adaptive service systems. An adaptive service system represents an individual, capability or function or a group of related services (Gill 2013). The focus of the adaptive service system is not to merely provide a service to another system, rather the focus is that the adaptive service systems interact with each other, and offer or consume services (e.g. service experience) for mutual benefiters or value co-creation. Value co-creation and adaptive service system is an emerging area of interest in the service science body of knowledge and industry (Spohrer and Kwan 2009; Gill 2013). An adaptive service system is:

- a collection or inventory of services that are offered based on agreed contract and service billing approach (e.g. pay-per-use, fixed subscription model)
- focused on mutual use and adaptation through proposal, contract, access and feedback mechanisms
- an abstraction mechanism that represents different types of both human and non-human entities (e.g. people, business units) who apply physical (e.g. material, tools) and non-physical resources (skills, knowledge) for value co-creation or mutual benefits or mutual satisfaction
- focused on value-proposition interactions via value, co-creation interaction channels for mutual value-creation
- an access rights based system with constraints to the interaction with other systems
- dependent on governance interaction mechanism for any dispute resolutions or service conflicts that may lead to dissatisfaction
- an ecology of different types of stakeholders such as service creator, provider, consumer, carrier, partner, auditor, observer, competitor, regulator and broker
- viewed with its concerns (e.g. performance, security, quality, compliance).

Agile enterprise as an eco-system of adaptive service systems focuses on the collaborative value-proposition or value co-creation. The adaptive service systems are housed in different geographically distributed facilities. A facility can be architected and built to support simple to mission critical complex and sensitive adaptive service systems. Facility could be located in the same or different country. Facility that is located
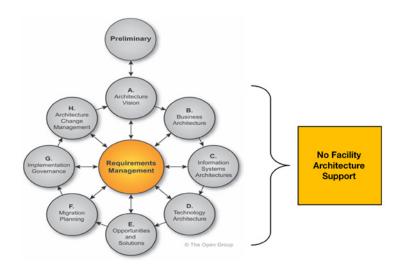
Figure 1: The Open Group Architecture Framework (TOGAF 9.1 2011)

outside the boundary of an enterprise and country may require complying with the multiple (e.g. local or global) legislative requirements and standards. The choice of interaction between two adaptive service systems could be impacted by the choice of facility where these adaptive service systems are actually hosted. For instance, an adaptive service system hosted at the facility in one country may not want to store their data on the data centre service system hosted at the different facility in the different country.

Agile enterprise operating in the distributed eco-system of adaptive service systems requires understanding and designing facility architecture as a part of their overall agile enterprise architecture. However, existing well-known enterprise architecture frameworks lack the support for developing facility architecture. For instance, TOGAF 9.1 is one of the well-known and most comprehensive architecture frameworks that provide the complete architecture development method and guidelines for developing and managing the traditional business, information system and technology domain architectures. Although, TOGAF 9.1 is a most comprehensive enterprise architecture framework, it does not provide any support for developing and managing the emerging facility architecture (see *Figure 1*).
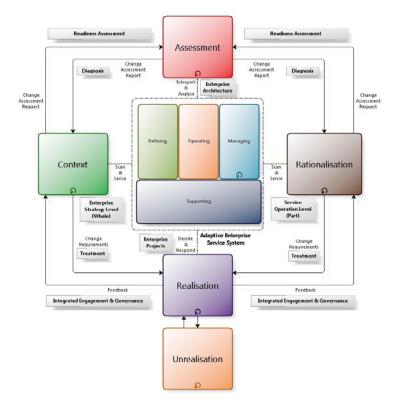
The Gill Framework

The Gill Framework is an agile enterprise architecture framework that complements the existing well-known TOGAF 9.1 and provides the new facility architecture domain. This framework (see *Figure 2*) builds on the extensive multi-disciplinary action-design empirical research in the well-known enterprise requirements, strategy, architecture, service, and project management disciplines. This agile enterprise architecture framework, along with the existing enterprise architecture tools, provides a practical support for developing and managing adaptive or agile enterprise architecture in the modern context. This framework has two main layers: (see *Figure 2*) inner layer and outer layer.

Figure 2: The Gill Framework (Copyright Gill 2012-13)

The inner layer is developed to assist in defining, operating, managing and supporting the complex enterprise as an adaptive enterprise service system. The defining capability defines the adaptive or agile enterprise architecture capability. The operating capability describes the adaptive enterprise architecture in its operating context in terms of its interaction architecture, factory architecture and facility architecture (see *Figure 3*). Factory architecture includes human, IT and solution architectures. Human architecture has a social architecture domain along with the other two business and information architectures. The managing capability is a set of integrated capabilities (e.g. enterprise strategy, architecture, project, service and requirements management) for developing and managing the adaptive enterprise. The supporting capability is a set of integrated capabilities (e.g. enterprise operating model, supply chain, intelligence, asset library, and method engineering) for supporting the other capabilities.

The outer layer presents the five adapting capabilities (e.g. context awareness, assessment, rationalization, realisation, and un-realisation) to guide the continuous adaptation of the adaptive enterprise architecture in response to internal and external changes. The outer layer enables the enterprise architecture adaptation or agility through the assessment and adoption of emerging technologies and their impact on the enterprise architecture.
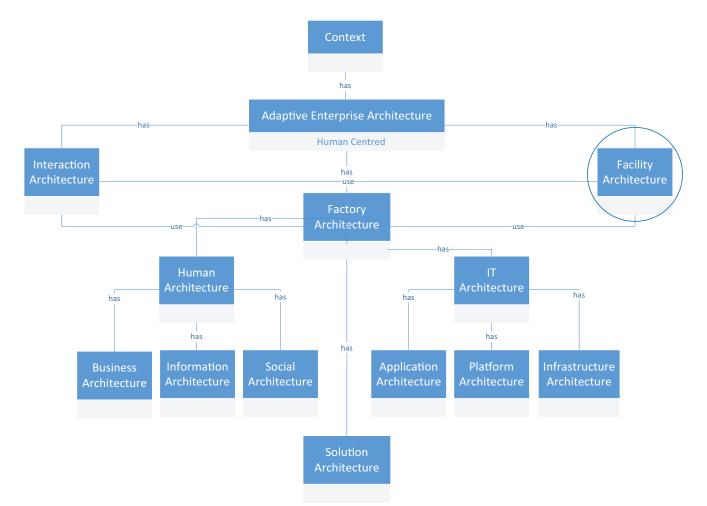

Figure 3: The Gill Framework – Domain Architectures (Copyright Gill 2012, 13)

Facility Architecture

Drawing on the ISO/IEC 42010 architecture definition, facility architecture can be defined as the "fundamental concepts or properties of a facility system in its environment embodied in its elements, relationships, and in the principles of its design and evolution". This definition refers to the facility as a "facility system". A facility system can be described by the "facility architecture". A facility system exists in and interacts with the environment and other facility systems in the environment. A facility system has properties, elements, and relationships. The architecture of a facility system is governed by its architecture principles like any other enterprise architecture domain such as business architecture principles, application architecture principles etc. The facility architecture essentially describes the structure of the overall facility system that influences the overall operating environment of an agile enterprise. Facility architecture plays an important role in the ongoing smooth operations, improvement, growth and transformation of an enterprise. Facility architecture has three types of facility architecture domains: spatial architecture, energy architecture and ancillary architecture. Additional domain types can be added if required.

Spatial architecture is a part of the overall agile enterprise architecture. Spatial is a location or real state that houses the infrastructure services (e.g. database server service, application server service, messaging service, enterprise service bus, and network equipment), energy and ancillary services (e.g. cooling). Spatial architecture can be looked at from different perspectives or elements to support enterprise transformation activities. The seven key elements of the spatial architecture are highly useable to assist enterprise transformation activities: spatial strategy, spatial principles, organization, value co-creation stream, spatial capability, spatial supply chain, and spatial event. Additional elements can be developed and added if required. Enterprises may use and review spatial architecture elements as a lens to identify current, transition and future state of the spatial architecture.

Energy architecture is a part of the overall agile enterprise architecture. Energy or power supply architecture is critical for the smooth running of the adaptive service systems and services hosted on a spatial architecture. Shortage of energy could lead to facility shutdown. Energy architecture can be looked at from different perspectives to support enterprise transformation activities. The seven key elements of the energy architecture are highly useable to assist enterprise transformation activities: energy strategy, energy principles, organization, value co-creation stream, energy capability, energy supply chain, and energy event. Additional elements can be developed and added if required. Enterprises may review these energy architecture elements as a lens to identify the current, transition and future state of the energy architecture in the context of overall facility architecture.

Ancillary architecture supports the overall facility architecture. Ancillary architecture includes a number of elements such as cooling, bandwidth, humidification, dehumidification, fire, safety, security, and mechanical. For instance, an adaptive service system facility could have a certain requirements for a cooling. It is important to make sure that there is a sufficient cooling available at a specific facility to support the present and future needs of the overall facility. Under or extra cooling capacity of a facility can become an issue since nearly 50% of the energy or power is allocated to cooling. Agile facility architecture aims to operate at or near its optimal cooling demands. Agile facility architecture should be able to accommodate unpredictable spikes or demand in cooling demand for supporting increasing or decreasing number of adaptive service systems. Agile facility architecture should have enough and adjustable cooling system.

An adaptive service system facility may have certain bandwidth requirements. Bandwidth of a facility is essentially a rate at which data or information travels from one service system facility to another service system facility within a given time period. Bandwidth can be expressed in terms of Bits or Bytes or Kilo Bytes or Giga Bytes per seconds. An interaction between two or more service systems may only be possible if certain minimal amount of bandwidth is guaranteed and available for sending and receiving data. A service system facility or network may impose certain limits on the total amount of data one service system can send to or receive from other service system within a given time period. The performance of a service system interaction is limited by the available connection bandwidth provided by the network facility provider. An extra or low bandwidth capacity could be problematic. Agile facility architecture aims to operate at or near to its optimal bandwidth. Agile facility architecture should be able to accommodate unpredictable spikes or demand in bandwidth demand for supporting the increasing or decreasing number of service systems interactions. Agile facility architecture should have enough and adjustable on-demand bandwidth.

The above mentioned domains and related elements describe the facility architecture within the overall context of agile enterprise architecture. Enterprise specific facility architecture can be developed by using these elements for supporting the other enterprise architecture domains for a particular situation.

Conclusion

Agile enterprise is a kind of eco-system or a system of complex adaptive service systems. The modern enterprise eco-system is housed in different geographically distributed facilities. A facility is a built system, which provides a place for hosting on-site and off-site, on-shore and off-shore, independent and inter-dependent human, non-human and IT adaptive service systems of the enterprise eco-system. The enterprise eco-system is a flexible and agile network that comprises of a number of different adaptive service systems that can leave or join the eco-system as required. Agile enterprises need to understand and design appropriate and agile facility architecture, as a part of their overall enterprise architecture, for smooth enterprise operations, improvement, transformation and growth. Facility architecture is also important for architecting and supporting other domain architectures. This white paper described the facility architecture elements from The Gill Framework, which can be used as a guideline for developing enterprise context specific facility architecture by using the available enterprise architecture tools.

Resources

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