Reference Model:

Information, Processes, and Automation Associated with

S*Representations for System Life Cycle Management

1.0 Purpose and Scope:

This purpose of this document is to provide a summary reference model of information, processes, and automation associated with Systematica™ Representations (S*Representations) used in life cycle management of systems. Its purpose includes identifying and understanding the packaging of intellectual property (IP) assets of various parties, as well as their intended uses and relationships.

This document is not an introduction or explanation of Systematica Methodology, and assumes a general awareness of the subject matter. Refer to the References for additional information.

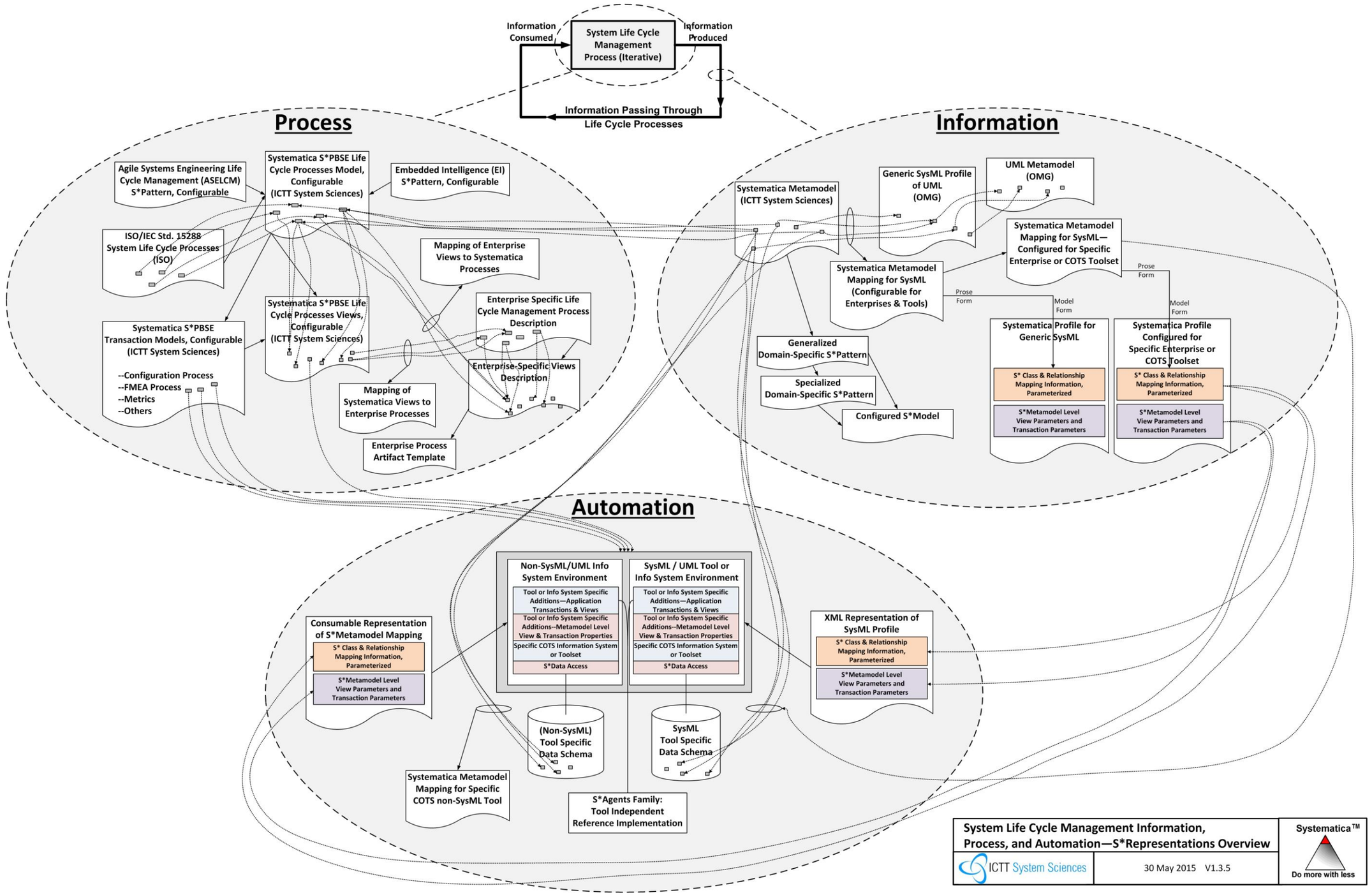
2.0 References

The following reference document includes sources and references to other citations herein:

1. "MBSE Methodology Summary: Pattern-Based Systems Engineering (PBSE), Based On S*MBSE Models", INCOSE Patterns Challenge Team, 2015, retrievable from: http://www.omgwiki.org/MBSE/lib/exe/fetch.php?media=mbse:patterns:pbse_extension_of_mbse--methodology_summary_v1.5.5a.pdf

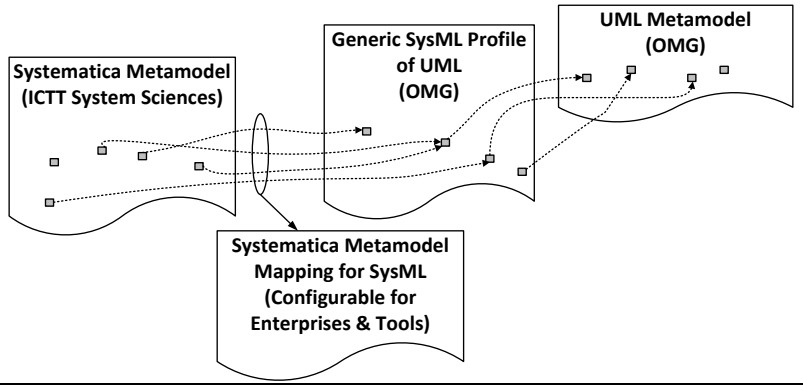
3.0 Reference Model

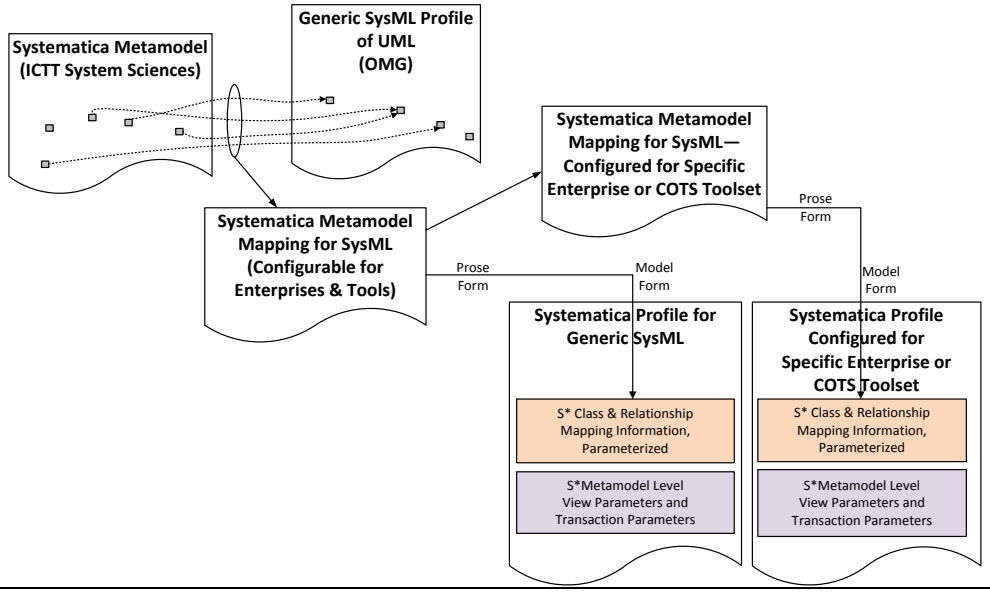
The following diagram provides an overall reference model. It is followed by definitions of each of the entities shown in the model.

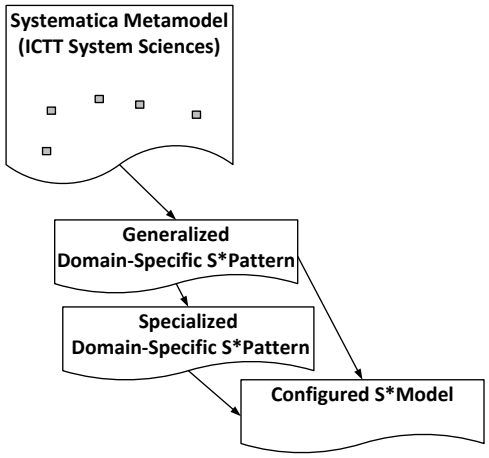


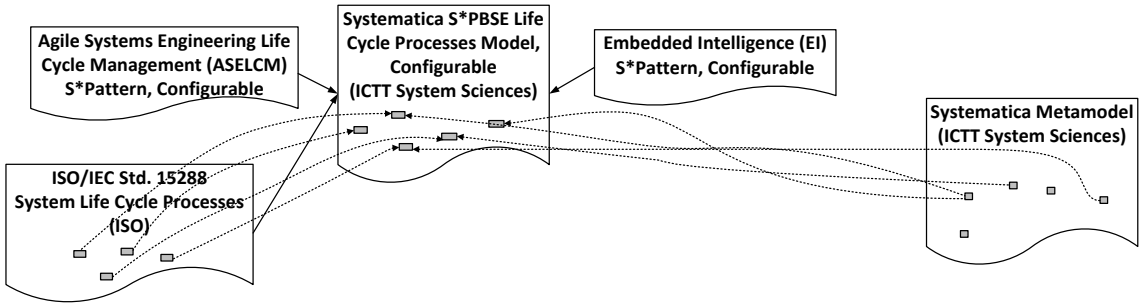
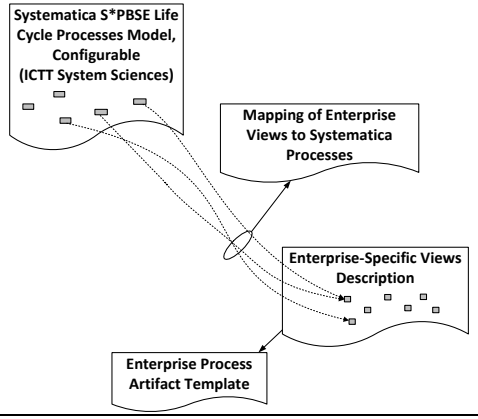
System Life Cycle Management Information, Process, and Automation—S*Representations Overview		
ICTT System Sciences	30 May 2015 V1.3.5	Systematica™ Do more with less

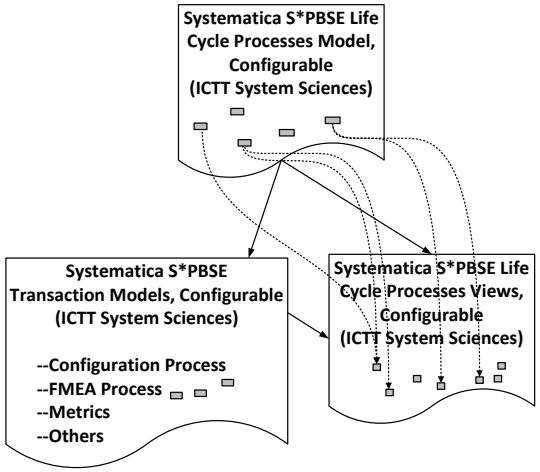
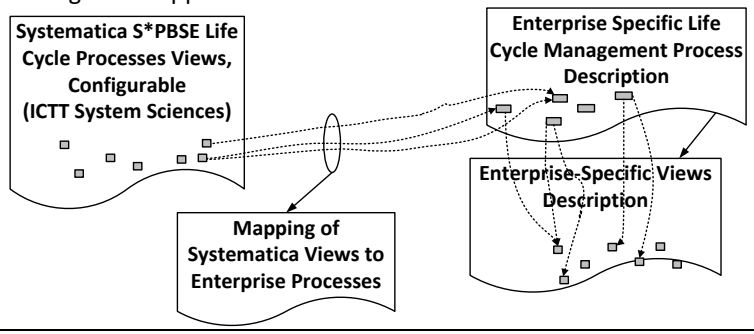
The following definitions refer to the extended reference boundaries diagram above, sections of which are excerpted in these definitions. Terms within definitions that are formatted in **bold underline** form are defined terms elsewhere within the same table of definitions.

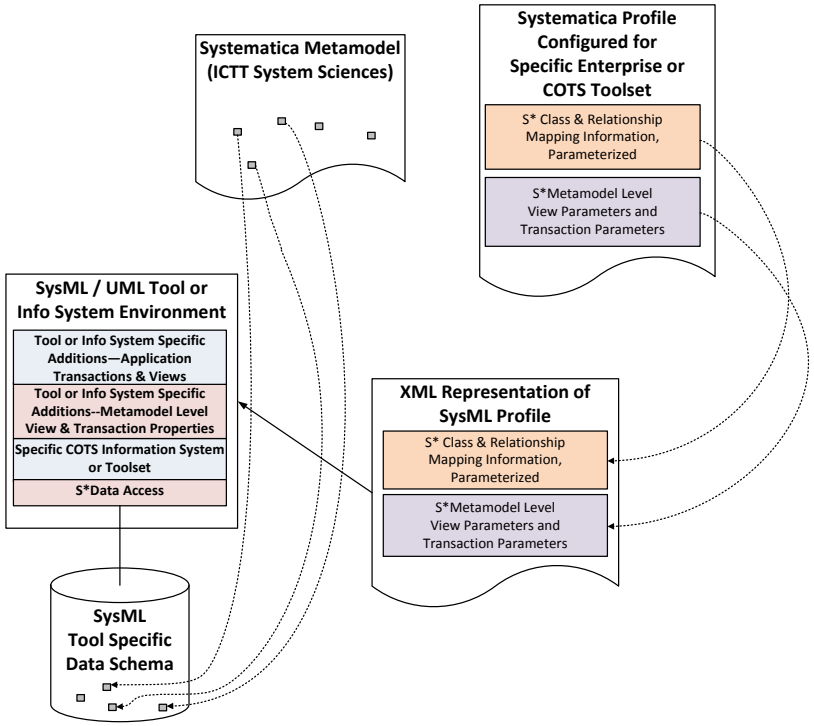
Information: System Models, Their Frameworks, and Descriptions Thereof	
UML Metamodel (OMG)	Unified Modeling Language (UML) framework, for the purpose of constructing UML models. Originally for modeling of information systems. Configurable UML Profiles originally provided for describing COTS UML modeling tool-specific implementations of the UML modeling standard. Subsequently made extensible, for the purpose of defining domain-specific modeling languages, with UML Profiles describing the alignment of such domain-specific frameworks with the UML standard. Periodically updated. Provides the foundation upon which SysML is defined.
Generic SysML Profile of UML (OMG)	Systems Modeling Language (SysML) framework for the purpose of constructing Systems Engineering models. The Generic SysML Profile of UML, periodically updated, is both a subset and extension of UML. Profiles may also be used to further extend or restrict this framework for use on specific tools, or in other specific ways.
Systematica Metamodel (ICTT System Sciences)	Systematica (S*) framework for the purpose of defining the underlying semantics of S*Models and S*Patterns, providing the smallest model semantics necessary to represent systems for purposes of engineering and science, while remaining independent of (and usable across) specific modeling languages and tools. Documented in the form of narrative and UML model document, with periodic version updates.
Systematica Metamodel Mapping for SysML (Configurable for Enterprises & Tools)	Formally describes how Systematica-compatible S*Models and S*Patterns can be represented in SysML, by mapping the S*Metaclasses, Relationships, Attributes, and Properties into the SysML Metamodel (SysML Profile). May be further specialized for specific SysML tools and enterprises. Documented in tabular prose form, as list of mappings of Systematica elements into SysML elements: 

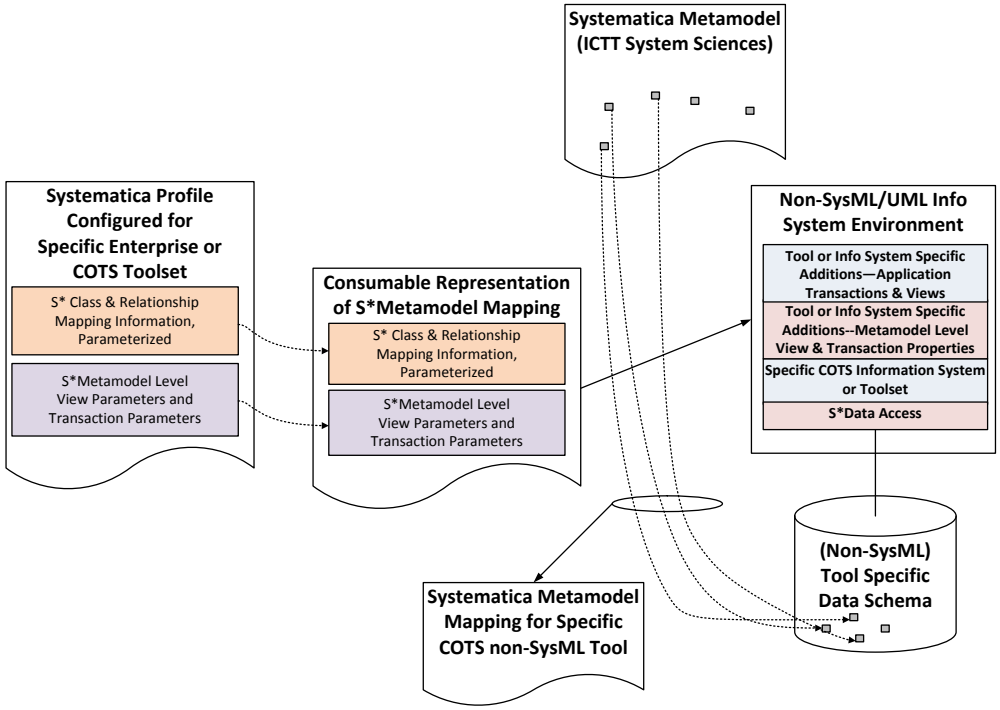
Systematica Profile for Generic SysML	Re-expresses the **Systematica Metamodel Mapping for SysML** (above) in the alternate form of a formal UML model construct called a UML Profile (in this case, the UML Profile for SysML, or SysML Profile). A UML Profile is made up of Stereotype Classes and Relationships, Tags, and Constrains, in diagrammatic and prose form. This diagrammatic and prose formal model may be serialized into XML for consumption by automated tools, as indicated under **XML Representation of SysML Profile** below In addition to the S*Class & Relationship Mapping Information, Parameterized, this Profile may also contain S*Metamodel Level View Parameters and Transaction Parameters. Those parameters describe certain aspects of the treatment of S*Metamodel elements when they appear in views and transactions. This profile may be specialized for tool-specific or enterprise-specific use. However, even in that case it is not intended to be specific to individual level views and transactions of life cycle processes or applications. Instead, these parameters describe view and transaction information common to the S*Metamodel level, but varying (as parameterized) across different classes, relationships, and attributes—for example, the visual appearance of S*Features versus S*Interactions, or the transaction behavior of S*States versus S*Interfaces. 
Systematica Profile Configured for Specific Enterprise or COTS Toolset	The **Systematica Profile for Generic SysML** may be specialized for an individual Enterprise, COTS Tool, or COTS Information System. Refer to the **Systematica Profile for Generic SysML**, where it is recommended how this specialization should be limited.
Systematica Metamodel Mapping for SysML— Configured for Specific Enterprise or COTS Toolset	The **Systematica Metamodel Mapping for SysML** may be further configured for use by a specific enterprise or in a specific tool or information system.
Generalized Domain-Specific S*Pattern	S*Patterns are configurable models of families of systems, conforming to the semantics of the S*Metamodel, expressed in any system modeling language (OMG SysML or otherwise) into which those semantics have been mapped by a Systematica Metamodel Mapping. A Generalized

	Domain-Specific S*Pattern describes a broad systems domain (e.g., health care, manufacturing, automotive, aerospace, etc.), and may be specialized or configured into S*Models of specific systems in that domain, for purposes of engineering or science. 
Specialized Domain-Specific S*Pattern	Specialized from a **Generalized Domain-Specific S*Pattern**, such a system pattern conforms to the semantics of the S*Metamodel, expressed in any system modeling language (OMG SysML or otherwise) into which those semantics have been mapped by a Systematica Metamodel Mapping. A Specialized Domain-Specific S*Pattern describes a specific family of systems (for example, a platform or product line), and may be specialized or configured into S*Models of specific systems in that domain, typically for purposes of engineering, science, or general life cycle management.
Configured S*Model	An MBSE model configured to describe a specific system for purposes of engineering or science, for use in the life cycle management processes of that system, in a model form consistent with the Systematica Metamodel. It may include system stakeholder value / fitness landscape, system requirements, system high level design, failure modes and effects, and other aspects.
Process: System Life Cycle Business Processes, and Descriptions Thereof	
ISO/IEC 15288 System Life Cycle Processes (ISO)	An international standard methodology-independent reference framework summarizing the processes performed throughout the lifecycle of a human-produced system of any kind, from earliest interest and conception, through planning, design, commissioning, production, and service, along with subsequent support, updates, and eventual decommissioning. Encompasses systems engineering as well as other system life cycle management processes, and provides for tailoring to the needs of specific enterprises, projects, and domains. Periodically updated by ISO, this framework has been used as the basis of more specific guidance (e.g., INCOSE Systems Engineering Handbook), and may be specialized to describe the related business processes of a specific enterprise or industry. By intention, this standard is not specific to any single approach to life cycle processes (e.g., model-based or otherwise).
Systematica S*PBSE Life Cycle Processes Model, Configurable (ICTT System Sciences)	A model-based representation of the life cycle management processes for human-produced systems. Derived from multiple sources, including (1) ISO/IEC 15288 System Life Cycle Processes, for processes, and (2) the Systematica Metamodel, for information passing through those processes. Shows how the ISO 15288 processes may be performed on information expressed in the form of system models (that is, performing MBSE) that conform to the Systematica Metamodel. Shows further how these processes can be extended to Pattern-Based System Engineering (PBSE), a form of MBSE that uses generalized models (called S*Patterns) of families of systems that can be rapidly configured and reused to describe individual system models (called S*Models), instead of creating new MBSE models from scratch on each project, and accumulating lessons over multiple projects in those patterns. Provides an MBSE discipline for performing Platform Management for improved leverage. Periodically

	updated, this life cycle processes model is itself described as an S*Pattern, configurable to fit the needs of different enterprises, projects, and domains. Its content includes inherited aspects of the **Agile Systems Engineering Life Cycle Management (ASELCM) S*Pattern** and the **Embedded Intelligence (EI) S*Pattern**: 
Agile Systems Engineering Life Cycle Management (ASELCM) S*Pattern, Configurable (ICTT System Sciences)	An S*Pattern representation of the systems relevant to understanding agility across the life cycle of systems—that is agile systems and agile systems engineering. This pattern is being employed by the INCOSE 2015-16 Agile Systems Engineering Life Cycle Model (ASELCM) Project, to discover, represent (as pattern configurations), and validate the applications across industry of agile principles and practices over the life cycles of systems, as an INCOSE input to the next generation of **ISO/IEC 15288 System Life Cycle Processes**.
Embedded Intelligence (EI) S*Pattern, Configurable (ICTT System Sciences)	An S*Pattern representation of the systems relevant to embedding intelligence in systems, whether in the form of automation, human beings, or hybrids thereof, and whether for purposes of managing system performance, configuration, security, faults, or accounting. In general, this pattern is used for representation of embedded intelligence at hierarchical levels in systems of all types. In the more specific use shown here, this pattern is used for representation of embedding, in life cycle management of systems, automated tools and information systems (e.g., engineering tools, PLMs, manufacturing control systems, etc.) and human practitioners (e.g., designers, operators, maintainers, others).
Enterprise-Specific Views Description	Describes the information "views" (documents, screens, artifacts) for managing system life cycles, produced or consumed by a specific enterprise's system life cycle management processes. Often exists in the form of an historical enterprise SOP or other standard.
Mapping of Enterprise Views to Systematica Processes	Describes a mapping (that is, a correlation or allocation) of information "views" from the **Enterprise-Specific Views Description** to the individual processes of the **Systematica S*PBSE Life Cycle Processes Model**. In addition to improving understanding or analysis of existing enterprise views, this mapping is also of value in planning migration of existing methods to future innovation and life cycle management approaches. 

Enterprise Process Artifact Template	Each such template describes a single information "view" (document, screen, artifact) for managing system life cycles, produced or consumed by a specific enterprise's system life cycle management processes.
Systematica S*PBSE Transaction Models, Configurable (ICTT System Sciences)	Describes the requirements (not design or implementation) for the process transactions (that is, information transformations) of the **Systematica S*PBSE Life Cycle Processes Model**. 
Systematica S*PBSE Life Cycle Process Views, Configurable (ICTT System Sciences)	Describes the information generalized "views" (documents, screens, artifacts) for managing system life cycles, produced or consumed by the **Systematica S*PBSE Life Cycle Processes Model**. These may be configured for individual enterprises, information systems and tools, or projects. They are described in the generalized context of **ISO/IEC 15288 System Life Cycle Processes**, but take advantage, where appropriate, of enhanced Model-Based Systems Engineering (MBSE) representations for the purposes intended.
Enterprise Specific Life Cycle Management Process Description	Describes the enterprise processes for managing system life cycles, for a specific enterprise's system life cycle management processes. Often exists in the form of an historical enterprise SOP or other standard.
Mapping of Systematica Views to Enterprise Processes	Describes a mapping (that is, a correlation or allocation) of information "views" from the **Systematica S*PBSE Life Cycle Processes Views** to the individual processes of the **Enterprise Life Cycle Management Processes Description**. In addition to improving understanding or analysis of existing enterprise processes, this mapping is also of value in planning migration of existing methods to future innovation and life cycle management approaches. 

Automation: Information System Support for Life Cycle Management Processes and Information	
SysML/UML Tool or Info System Environment	An automated modeling tool or information system that is SysML capable—able to manage system life cycle data consistent with a SysML Profile—in particular, a Systematica Profile, communicated to that tool or information system by its expression as an **XML Representation of SysML Profile**. This overall information system environment includes not only a specific COTS information system or toolset, but also additions to it such as application transactions and views, along with data access methods to access stored repository information: 
SysML Tool Specific Data Schema	The organization, consistent with a SysML Profile, of a persistent data repository that is used to store system life cycle management information.
XML Representation of SysML Profile	An alternate form of the Systematica Profile, in the form of serialized XML representing the Profile model, for use in exchange / loading into SysML modeling tools. As a SysML Profile, it consists of Stereotype Classes and Relationships, Tags, and Constraints. For additional information about its contents and scope, see **Systematica Profile Configured for Specific Enterprise or COTS Toolset** and **Systematica Profile for Generic SysML**.

Non-SysML/UML Info System Environment	A automated modeling tool or information system that is not specifically SysML capable, but has a schema that has been mapped to the Systematica Metamodel, and used to manage system life cycle data consistent with that mapping. This overall information system environment includes not only a specific COTS information system or toolset, but also additions to it such as application transactions and views, along with data access methods to access stored repository information: 
(Non-SysML) Tool Specific Data Schema	The organization, consistent with a mapping to the Systematica Metamodel, of a persistent data repository that is used to store system life cycle management information.
Systematica Metamodel Mapping for Specific COTS non-SysML Tool	Formally describes how Systematica-compatible S*Models and S*Patterns can be represented in a specific COTS information system that is not SysML oriented, by mapping the S*Metaclasses, Relationships, Attributes, and Properties into the information system's schema. Documented in tabular prose form, as list of mappings of Systematica elements into information system's schema elements.
Consumable Representation of S*Metamodel Mapping	The form of information, describing the Systematica Metamodel Mapping for this information system, as consumed by the information system to configure it for that purpose.

S*Agents Family: Tool Independent Reference Implementations (ICTT System Sciences)	An implementation of selected transactions and views, to illustrate targeted system life cycle management steps. Provides an example working implementation with design documentation, intended for limited initial operational use and primarily as a reference for creating a production implementations using other technologies