



Ministério da  
**Ciência, Tecnologia  
e Inovação**

CTI Renato Archer

Technical Report CTI – TRT0129114

# CERTICS Assessment Reference Model Conformity to ISO/IEC 15504

Version 1.0

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This technical report was produced as part of the Research and Development activities of the technical members of Divisão de Melhoria de Processo de Software – DMPS, of the Centro de Tecnologia da Informação Renato Archer – CTI ([www.cti.gov.br](http://www.cti.gov.br)), located at Rodovia Dom Pedro I, km 143,6, Campinas – SP – Brasil.

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#### Change History

Date	Version	Description	Author	Review	Approval
June 27 <sup>th</sup> 2014	1.0	First version, registration in SIGTEC, publication in CERTICS website ( <a href="http://www.cti.certics.gov.br">www.cti.certics.gov.br</a> )	CFS	FSA	STM

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## **Executive Summary**

The CERTICS Assessment Reference Model (CERTICS Model) is a reference model to assess software process in order to determine whether a given software is resulting from technological development and innovation carry out in Brazil. CERTICS Model is complemented by CERTICS Assessment Method (CERTICS Method). CERTICS Model uses ISO/IEC 15504 Standard for Process Assessment as a reference for its structure. The CERTICS Model is described in a detailed version in a technical report.

The conformity of CERTICS Model to ISO/IEC 15504 requirements are demonstrated in Statements of Conformity Tables with three columns: a sequential identification starting from S01, an ISO/IEC requirement and a conformity statement describing where and how the requirement is attended. From an analysis of the statements of conformity of CERTICS Model with the ISO/IEC 15504-2 requirements for Process Reference Model and Process Assessment Model, we conclude that CERTICS Model can be considered as a Process Reference Model and Process Assessment Model. From similar analysis for ISO/IEC 15504-7 requirements we also conclude that CERTICS Model can be considered as an Organizational Maturity Model. The documentation of CERTICS Model, however, should be improved in order to facilitate the understanding of how these requirements are addressed.

## **Resumo Executivo**

*O Modelo de Referência para Avaliação CERTICS (Modelo CERTICS) é um modelo de referência para avaliar o processo de software, a fim de determinar se um determinado software é resultante de desenvolvimento e inovação tecnológica realizados no Brasil. O Modelo CERTICS é complementado pelo Método de Avaliação CERTICS (Método CERTICS). O Modelo CERTICS utiliza a Norma ISO/IEC 15504 Norma para Avaliação de Processos como uma referência para a sua estrutura. O Modelo CERTICS é descrito em uma versão detalhada em um relatório técnico.*

*A conformidade da CERTICS com os requisitos da ISO/IEC 15504 são demonstrados nas Declarações de Conformidade das Tabelas de conformidade com três colunas: uma identificação sequencial a partir de S01, um requisito da ISO/IEC 15504 e uma declaração de conformidade que descrever onde e como o requisito é atendido. A partir de uma análise das declarações de conformidade do Modelo CERTICS com os requisitos da ISO/IEC 15504-2 para o Modelo de Referência do Processo e Modelo para Avaliação de Processo, concluímos que o Modelo CERTICS pode ser considerado como um Modelo de Referência do Processo e Modelo para Avaliação de Processo. A partir de uma análise semelhante para a os requisitos da ISO/IEC 15504-7 também podemos concluir que o Modelo CERTICS pode ser considerado como um Modelo de Maturidade Organizacional. A documentação do Modelo CERTICS, no entanto, deve ser melhorada, a fim de facilitar a compreensão de como esses requisitos são atendidos.*

## 1. Introduction

This technical report presents statements of conformity of CERTICS Assessment Reference Model (CERTICS Model) [4] with the requirements of ISO/IEC 15504-2 [1] and ISO/IEC 15504-7 [2].

ISO/IEC 15504 series of standards, also known as SPICE (Software Process Improvement and Capability dEtermination) established requirements, a measurement framework, guidelines and examples of models and methods for process assessment [1] [2]. Using ISO/IEC 15504, different models and methods can be developed to address specific objectives and domains. ISO/IEC 15504-2 “addresses the assessment of process and the application of process assessment for improvement and capability determination” [1]. ISO/IEC 15504-7 “addresses the expression of the results of assessment of processes in terms of the overall maturity of an organizational unit, and the application of the results of assessment of organizational maturity for process improvement and capability determination” [2].

The term Assessment Methodology is used to name a set composed by an Assessment Reference Model and an Assessment Method. The CERTICS Assessment Methodology for Software (CERTICS Methodology) is a methodology to assess software process in order to determine a specific criterion, named as the Fundamental Concept: whether a given software is resulting from technological development and technological innovation carry out in Brazil. A design decision for CERTICS Methodology was to use ISO/IEC 15504 Standard for Process Assessment as a reference for two major methodological components: CERTICS Assessment Reference Model (CERTICS Model) and CERTICS Assessment Method (CERTICS Method). A special attention was given to the requirement to identify and take actions to achieve consensus within the community of interest of the methodology.

The CERTICS Model is described in a detailed version in a technical report [4]. The CERTICS Methodology, that describes an overview of the CERTICS Model and the CERTICS Assessment Method, is documented in another technical report [3].

There are three types of conformance of models to the requirements of ISO/IEC 15504: conformance of Process Reference Models, Process Assessment Models and Organizational Maturity Models. Conformity to the requirements of ISO/IEC 15504 may be verified by self-declaration (first party), a second party and a third party. This Section presents statements of conformity of CERTICS Model with ISO/IEC 15504-2 and ISO/IEC 15504-7 requirements. These statements were verified by self-declaration.

The statements in this technical report implement the mechanism for verification of conformity, defined in ISO/IEC 15504-2 [1] Section 7 and ISO/IEC 15504-7 [2] Section 7. For verifying conformity of Process Reference Models (PRM), ISO/IEC 15504-2 defines: “Since a [PRM] may be the material produced by a community of interest, or a relevant International or National Standard, or Publicly Available Specification, verification of the extent to which such models meet the requirements of this International Standard may be through either demonstration of conformity or demonstration of compliance. The party performing verification of conformity shall obtain objective

evidence that the [PRM] fulfills the requirements set forth in ISO/IEC 15504-2 clause 6.2. Objective evidence of conformance shall be retained.”

In a Note, ISO/IEC 15504-2 clarifies that “Conformity is fulfillment by a product, process or service of specified requirements. Compliance is adherence to those requirements contained in standards and technical reports which specify requirements to be fulfilled by other standards, technical reports or International Standardized Profiles (ISPs) (e.g. reference models and methodologies)”.

The CERTICS Model is a Process Reference Model, a Process Assessment Model and an Organizational Maturity Model. The statements of conformity are described in a set of tables with three columns: a statement sequential identification starting from S01, an ISO/IEC requirement and a conformity statement. Then a conformity statement concludes with a comment on how the requirement is addressed. As the CERTICS Model document is in Portuguese, the Table 1 presents an English translation to its outline.

Table 1 - CERTICS Model document outline in Portuguese and English

<b>Original Title in Portuguese</b>	<b>Title in English Translation</b>
Resumo Executivo	Executive Summary
1. Introdução	1. Introduction
2. Visão Geral do Modelo de Referência da CERTICS	2. CERTICS Reference Model Overview
2.1 Objetivo	2.1 Objective
2.2 Conceito Fundamental	2.2 Fundamental Concept
2.3 Arquitetura do Modelo de Referência	2.3 Reference Model Architecture
2.4 Notação da descrição do Modelo de Referência	2.4 Notation of Reference Model Description
3. Áreas de Competência do Modelo de Referência da CERTICS	3. Competence Areas of the CERTICS Reference Model
3.1 Área de Competência Desenvolvimento Tecnológico (DES)	3.1 Technological Development Competence Area (DES)
3.2 Área de Competência Gestão de Tecnologia (TEC)	3.2 Technological Management Competence Area (TEC)
3.3 Área de Competência Gestão de Negócios (GNE)	3.3 Business Management Competence Area (GNE)
3.4 Área de Competência Melhoria Contínua (MEC)	3.4 Continuous Improvement Competence Area (MEC)
4. Considerações Finais	4. Final Considerations
5. Glossário	5. Glossary

## 2. Statements of conformity for a Process Reference Model

Table 2 presents the statements of conformity with the requirements for a Process Reference Model.

Table 2 - Statements of conformity with the requirements for a Process Reference Model.

Id	Requirements in ISO/IEC 15504-2	Statement of CERTICS Model Conformity
S01	6.2.3.1 A Process Reference Model shall contain:	The following statements attend this requirement.
S02	a) a declaration of the domain of the Process Reference Model;	The declaration of the domain is in CERTICS Model Section 2.2: Fundamental Concept. The domain includes software technological development and innovation.
S03	b) a description, meeting the requirements of clause 6.2.4 of this International Standard, of the processes within the scope of the Process Reference Model;	The description is in CERTICS Model Section 3: Competence Areas. There are descriptions of four Competence Areas, identified as DES, TEC, GNE and MEC within the scope of CERTICS Model. A Competence Area corresponds to a process, as explained in Statement S12.
S04	c) a description of the relationship between the Process Reference Model and its intended context of use;	The description is in CERTICS Model Section 2.2: Fundamental Concept. The intended context of use is to assess software process for the Fundamental Concept. CERTICS Model is intended for use in multiple organizational contexts and to meet a full range of different business needs, application domains, and sizes. It is flexible with regard to type of software.
S05	d) a description of the relationship between the processes defined within the Process	The description is in CERTICS Model Section 3.4: Continuous Improvement (MEC) Competence Area. There is one relevant relationship. It is between MEC and the

	Reference Model;	other three competence areas.
S06	6.2.3.2 The Process Reference Model shall document the community of interest of the model and the actions taken to achieve consensus within that community of interest:	There are at least two related community of interest: the Brazilian Federal Government and the relevant software stakeholders. CERTICS Methodology is a public policy instrument supported by federal law. From the federal government, MCTI is responsible to implement CERTICS. Therefore the federal government, represented by MCTI, is a community of interest. In other to be accepted, the other community of interest includes buyers, governmental agencies, specialists, software organizations, software organization associations, and others.
S07	a) the relevant community of interest shall be characterized or specified;	The characterization is indicated in CERTICS Model Sections 1: Introduction and 2. Objectives. An overview is described in the previous Statement S07.
S08	b) the extent of achievement of consensus shall be documented;	The actions taken to achieve consensus within the Brazilian Federal Government as a community of interest are related with a continuous relationship as a demanding and joint public presentations and publications. The extent of consensus achieved is evidenced by the publication of legal instruments indicating CERTICS Methodology as the implementation of the related federal law. The actions taken to achieve consensus and the extent of consensus achieved within the relevant software stakeholders as the other community of interest are described in Section 3 of this article.
S09	c) if no actions are taken to achieve consensus, a statement to this effect shall be documented;	Not applicable because actions were taken to achieve consensus as described in the previous Statement S08.
S10	6.2.3.3 The processes defined within a Process	The descriptions and identification are in CERTICS Model Section 3: Competence



	Reference Model shall have unique process descriptions and identification.	Areas.
S11	NOTE Any elements contained in a Process Reference Model that are not included in this clause are to be considered informative.	All elements that are not included in this clause are considered informative.
S12	6.2.4 Process descriptions: The fundamental elements of a Process Reference Model are the descriptions of the processes (...). The process descriptions (...) incorporate a statement of the purpose of the process which describes at a high level the overall objectives of performing the process, together with the set of outcomes which demonstrate successful achievement of the process purpose. These process descriptions shall meet the following requirements:	The descriptions are in CERTICS Model Section 3: Competence Areas. The fundamentals elements of CERTICS Model are the descriptions of four Competence Areas, identified as DES, TEC, GNE and MEC. A Competence Area corresponds to a process. Each Competence Area is defined by a key question and outcomes. A key question represents the purpose written as a question. The key question for TEC, for example, which is "Is the software maintained autonomous and technologically competitive?" correspondents to purpose "to maintain the software autonomous and technologically competitive. Therefore each Competence Area is a process to achieve its purpose. TEC, for example, corresponds to a process to maintain the software autonomous and technologically competitive.
S13	a) a process shall be described in terms of its purpose and outcomes;	The descriptions are in CERTICS Model Section 3: Competence Areas. Each Competence Area (process) is described in terms of key question (purpose) and outcomes.
S14	b) in any process	They are necessary and sufficient to achieve

	description the set of process outcomes shall be necessary and sufficient to achieve the purpose of the process;	the purpose of the process. Technical reviews were performed to adjust and validate the outcomes as necessary and sufficient to answer the key question (achieve the purpose) of the competence area (process).
S15	c) process descriptions shall be such that no aspects (...) beyond level 1 are contained or implied.	No aspect beyond level 1 are contained or implied. Technical reviews were performed to adjust and validate the “level 1” competence area (process) descriptions.
S16	An outcome statement describes one of the following: Production of an artefact; A significant change of state; Meeting of specified constraints (...).	All outcome statements follow this description. Technical reviews were performed to adjust and validate the sixteen outcomes.

### 3. Statements of conformity for a Process Assessment Model

Table 3 presents the statements of conformity with the requirements for a Process Assessment Model.

Table 3 - Statements of conformity with the requirements for a Process Assessment Model.

Id	Requirements in ISO/IEC 15504-2	Statement of CERTICS Model Conformity
S17	6.3.2 Process Assessment Model scope	This requirement is attended by the following statements.
S18	6.3.2.1 A Process Assessment Model shall relate to at least one process from the specified Process Reference Model(s).	The specified PRM is the CERTICS Model itself, as indicated in the section 2 of this technical report. Therefore all four competency Areas (process) are used for CERTICS Model as a PAM.
S19	6.3.2.2 A Process Assessment Model shall address, for a given process, all, or a continuous subset, of the levels (starting at level 1) of the Measurement Framework for process capability for each of the processes within its scope.	CERTICS Model addresses solely process capability level 1, therefore it is a continuous subset starting at level 1. This information, however, is not in the CERTICS Model document. It is in the CERTICS Methodology section 4 – Ratings Rules.
S20	6.3.2.3 A Process Assessment Model shall declare its scope of coverage in the terms of:	The following statements S21 to S23 attend this requirement.
S21	a) the selected Process Reference Model(s);	The specified PRM is the CERTICS Model itself, as indicated in the section 2 of this technical report.
S22	b) the selected processes taken from the Process Reference Model(s);	All four competency Areas (process) are taken from the CERTICS Model as a PRM.

S23	c) the capability levels selected from the Measurement Framework.	See statement S19. CERTIS Model addresses solely process capability level 1.
S24	<p>6.3.3 Process Assessment Model indicators: A Process Assessment Model shall be based on a set of indicators that explicitly addresses the purposes and outcomes, as defined in the selected Process Reference Model, of all the processes within the scope of the Process Assessment Model; and that demonstrates the achievement of the process attributes within the capability level scope of the Process Assessment Model. The indicators focus attention on the implementation of the processes in the scope of the model.</p>	<p>The indicators for processes are in subsection Guidelines and subsection Examples of types of Evidences, in the description of each Outcome in the CERTICS Model. There are indicators for each outcome. They are practices and examples of artefacts. Each set of practices covers the outcome. For the indicators for process attributes, considering Statement S19, they are explicitly described, but CERTICS Model follows the Capability Level 1 (and its process attribute and indicators) as described in ISO/IEC 15504-5 PAM Section 6. The CERTICS Model text is as follows, as in ISO/IEC 15504-5 with a replacement of “Clause 5 of this document” by “Section 3: Competence Areas of CERTICS Model document” and considering “process” as “competence area” and “purpose” as “key question”:</p> <p>“6.1 Level 1: Performed process</p> <p>6.1.1 PA 1.1 Process performance attribute.</p> <p>The process performance attribute is a measure of the extent to which the process purpose is achieved. As a result of full achievement of this attribute:</p> <p>a) the process achieves its defined outcomes.</p> <p>6.1.1.1 Generic Practices for PA 1.1          GP 1.1.1 Achieve the process outcomes          - Perform the intent of the base practices.          - Produce work products that evidence the process outcomes.</p>

		<p>NOTE: The assessment of a performed process is based on process performance indicators, which are defined in [Section 3: Competence Areas of CERTICS Model]</p> <p>6.1.1.2 Generic Resources for PA 1.1 Resources are used to perform the intent of process specific base practices. [PA 1.1 Achievement a]</p> <p>6.1.1.3 Generic Work Products for PA 1.1 21-00 Work product [PA 1.1 Achievement a] Work products exist that provide evidence of the achievement of the process outcomes.”</p>
S25	<p>6.3.4 Mapping Process Assessment Models to Process Reference Models: A Process Assessment Model shall provide an explicit mapping from the relevant elements of the model to the processes of the selected Process Reference Model and to the relevant process attributes of the Measurement Framework. The mapping shall be complete, clear and unambiguous. The mapping of the indicators within the Process Assessment Model shall be to:</p>	<p>The following statements S26 and S27 attend this requirement.</p>
S26	<p>a) the purposes and outcomes of the processes in the specified Process</p>	<p>The descriptions are in CERTICS Model Section 3: Competence Areas. Each Competence Area (process) is described in terms of key question (purpose) and</p>

	Reference Model;	outcomes. All four competency Areas (process) are taken from the CERTICS Model as a PRM.
S27	b) the process attributes (including all of the results of achievements listed for each process attribute) in the Measurement Framework.	See statement S24 for process attributes. CERTIS Model addresses solely process capability level 1.
S28	6.3.5 Expression of assessment results: A Process Assessment Model shall provide a formal and verifiable mechanism for representing the results of an assessment as a set of process attribute ratings for each process selected from the specified Process Reference Model(s). NOTE The expression of results may involve a direct translation of Process Assessment Model ratings into a process profile as defined in this international standard, or the conversion of the data collected during the assessment (with the possible inclusion of additional information) through further judgement on the part of the assessor.	The expression of assessment results is described in CERTICS Methodology section 4 – Ratings Rules.

#### 4. Statements of conformity for an Organizational Maturity Model

Table 4 presents the statements of conformity with the requirements for an Organizational Maturity Model.

Table 4: CERTICS Model and ISO/IEC 15504-7

Id	Requirements in ISO/IEC 15504-7	Statement of CERTICS Model Conformity
S29	4.4.1 Model Characteristics	The following statements S30 to S36 attend this requirement.
S30	An Organizational Maturity Model relates to a specified domain of application or set of related domains of application. The domain of application of the Organizational Maturity Model shall be specified clearly and unambiguously.	Same of statement S02 of Table 02
S31	The Organizational Maturity Model shall document the community of interest of the Organizational Maturity Model and the actions taken to achieve consensus within that community of interest:	Same of statement S06 of Table 02
S32	the relevant community of interest shall be characterized or specified;	Same of statement S07 of Table 02
S33	the extent of achievement of consensus shall be documented;	Same of statement S08 of Table 02
S34	if no actions are taken to achieve consensus, a statement to this effect shall be documented.	Do not apply

S35	<p>An Organizational Maturity Model shall be based upon one or more specified Process Assessment Model(s). The Organizational Maturity Model shall specify the elements, drawn from the specified Process Assessment Model(s) that constitute the elements of the Organizational Maturity Model, and the relationships between these elements and the organizational Maturity Levels specified in Clause 4.1. NOTE "Elements" is used in the same context as in Clause 6.3.4 of ISO/IEC 15504-2.</p>	<p>The OMM is based on the CERTICS Model itself, as the PAM, as indicated in the section 2 of this technical report. Therefore all four competency Areas (process) are used for CERTICS Model as an OMM.</p>
S36	<p>An Organizational Maturity Model shall specify a continuous subset of Maturity Levels defined in the Measurement Framework for the assessment of organizational maturity, starting with Maturity Level 1 (through the basic process set), for each of the Maturity Levels within its scope. NOTE Annex A contains an exemplar Organizational Maturity Model, based upon ISO/IEC 15504-5 as the specified Process Assessment Model.</p>	<p>The maturity levels addressed is in the CERTICS Methodology section 4 – Ratings Rules. CERTIS Model addresses solely maturity level 1.</p>



S37	4.4.2 Basic Process Set: An Organizational Maturity Model shall include a set of elements from the Process Assessment Model(s) constituting the basic process set for the model. The basic process set shall include:	The following statements S38, S39 and S40 attend this requirement.
S38	- A minimum set of elements that define Level 1 Maturity for all assessments based on the model;	The minimal set is composed of the four Competence areas, as indicated in the CERTICS Methodology section 4 – Ratings Rules.
S39	- Additional elements that are required for assessments in particular domains or scope of application; and	No required additional elements are needed. Therefore they are not defined.
S40	- Additional elements that are optional depending on the particular circumstances of the organization.	No optional additional elements are defined.
S41	4.4.3 Extended Process Sets: An Organizational Maturity Model shall include sets of elements constituting the extended process sets for each Maturity Level addressed by the model.	As there is only maturity level 1, no extended process sets are needed. Therefore they are not defined.

## 5. Conclusion

From an analysis of the statements of conformity of CERTICS Model with the ISO/IEC 15504-2 requirements for Process Reference Model and Process Assessment Model, we conclude that CERTICS Model can be considered as a Process Reference Model and Process Assessment Model. From similar analysis for ISO/IEC 15504-7 requirements we also conclude that CERTICS Model can be considered as an Organizational Maturity Model. The documentation of CERTICS Model, however, should be improved in order to facilitate the understanding of how these requirements are addressed.

## References

1. The International Organization for Standardization and the International Electrotechnical Commission (ISO/IEC), ISO/IEC 15504-2 - Information technology - Process assessment - Part 2: Performing an assessment, 2003.
2. ISO/IEC, ISO/IEC 15504-7 - Information technology - Process assessment - Part 7: Assessment of organizational maturity, 2008.
3. Equipe CERTICS, Metodologia de Avaliação da CERTICS para Software - Documento de Definição - Versão 1.1, Relatório Técnico CTI Renato Archer – TRT0012113, 2013 (available, in Portuguese, from [www.certics.cti.gov.br](http://www.certics.cti.gov.br)).
4. Equipe CERTICS, Modelo de Referência para Avaliação da CERTICS - Documento de Detalhamento - Versão 1.1, Relatório Técnico CTI Renato Archer – TRT0084113, 2013 (available, in Portuguese, from [www.certics.cti.gov.br](http://www.certics.cti.gov.br)).