



# The relationship between ISO/IEC 15504 process capability levels, ISO 9001 certification and organization size: An empirical study

Ho-Won Jung<sup>a,\*</sup>, Robin Hunter<sup>b,1</sup>

<sup>a</sup> Department of Business Administration, Korea University, Anam-dong 5Ka, Sungbuk-gu, Seoul 136-701, Republic of Korea

<sup>b</sup> Department of Computer Science, University of Strathclyde, Richmond Street, Glasgow G1 1XH, UK

Received 13 November 2000; received in revised form 31 December 2000; accepted 12 February 2001

## Abstract

The gradual spread in the use of ISO 9001 and ISO/IEC 15504 (also known as software process improvement and capability determination (SPICE)) has raised questions such as “At what ISO/IEC 15504 capability level would one expect an ISO 9001 certified organization’s processes to be?” and “Is there any significant difference between the ISO/IEC 15504 capability levels achieved by the processes of ISO 9001 certified organizations and those of non ISO 9001 certified organizations?”. This paper provides answers to those questions as well as to the following question “Is there any significant difference in the capability levels achieved by the ISO/IEC 15504 processes of organizations with a large information technology (IT) staff and those with a small IT staff?” In order to answer these questions, we analyzed a data set including 691 process instances (PIs) taken from 70 SPICE phase 2 trial assessments performed over the two years from September 1996 to June 1998. Results show that the ISO/IEC 15504 processes of the ISO 9001 certified organizations attained capability levels of around 1–2.3 in 15504 terms. Results also show differences between the capability levels achieved by ISO 9001 certified organizations and non ISO 9001 certified organizations, as well as between organizations with a large IT staff and those with a small IT staff. © 2001 Elsevier Science Inc. All rights reserved.

**Keywords:** Bootstrap; Confidence interval; Capability level; Permutation test; ISO 9001 certification; SPICE assessments

## 1. Introduction

The software process improvement and capability determination (SPICE) project is an ongoing project supporting ISO/IEC JTC1/SC7/WG10<sup>2</sup> in the development and trialing of the emerging standard ISO/IEC 15504 for software process assessment, capability determination, and software process improvement. ISO/IEC JTC1/SC7/WG10 has developed a technical report 2 (TR2) (ISO/IEC TR2, 1998) consisting of the document set shown in Table 1. In the development of these

documents, the SPICE project has empirically evaluated successive versions of the document sets of the emerging international standard through a series of trials (El Emam and Goldenson, 1995; Goldenson and El Emam, 1996; MacLennan and Ostrolenk, 1995; Smith and El Emam, 1996; ISO/IEC, 1999; Woodman and Hunter, 1998; El Emam and Jung, 2000). More information about ISO/IEC 15504 may be found in ISO/IEC 15504 (1998) and in (El Emam et al., 1998).

ISO 9001 (1997) contains 20 clauses (see Appendix A) that collectively provide the minimum requirements for setting up a quality management system for use in software development and maintenance, as well as in other industries. Satisfaction of all the requirements leads to ISO 9001 certification. ISO 9000-3 (1997) contains software specific guidelines for the use of ISO 9001, and TickIT (1999) is an initiative, which originated in the UK, to promote the application of ISO 9001 to software.

Although ISO 9001 and ISO/IEC 15504 have different origins, i.e., ISO 9001 is a generic standard for quality management and assurance while 15504 was created solely for software process assessment, capability determination, and process improvement, the two

\* Corresponding author. Tel.: +82-2-3290-1938; fax: +82-2-922-7220.  
E-mail addresses: hwjung@mail.korea.ac.kr (H.-W. Jung), rbh@cs.strath.ac.uk (R. Hunter).

<sup>1</sup> Tel.: +44-141-548-3585; fax +44-141-552-5330.

<sup>2</sup> Working Group 10 of Subcommittee 7 (Software Engineering Standardization) under a Joint Technical Committee 1 for the international organization for standardization (ISO) and the international electrotechnical commission (IEC). WG10 is working for development of standards and guidelines covering methods, practices and application of process assessment in software product procurement, development, delivery, operation, maintenance and related service support.

Table 1  
A set of documents in ISO/IEC 15504

Part 1: Concepts and introductory guide
Part 2: A reference model for processes and process capability
Part 3: Performing an assessment
Part 4: Guide to performing assessments
Part 5: An assessment model and indicator guidance
Part 6: Guide to competency of assessors
Part 7: Guide for use in process improvement
Part 8: Guide for use in determining supplier process capability
Part 9: Vocabulary

standards are intuitively similar, as has been shown in a comparative study of the two standards (Hailey, 1998). To the best of our knowledge, there are no studies which assess the degree of similarity between the two standards such as is seen in a comparative study of ISO 9001 and capability maturity model (CMM) (Paulk et al., 1993) conducted by (Paulk, 1995). In the study, Paulk attempted to answer questions such as “At what level in the CMM would an ISO 9001 compliant organization be?” and “Can a CMM level 2 (or 3) organization be considered compliant with ISO 9001?”.

The aim of this study is to consider and, if possible, to provide an answer to the questions relating to ISO 9001 and ISO/IEC 15504

- At what ISO/IEC 15504 capability level would one expect an ISO 9001 certified organization’s processes to be?
- Is there any significant difference in the SPICE capability levels achieved by the processes of ISO 9001 certified organizations and those of non ISO 9001 certified organizations?
- Is there any significant difference in the capability levels achieved by the SPICE processes of organizations with a large information technology (IT) staff and those with a small IT staff?

This study answers the three questions above empirically by analyzing a data set taken from 70 SPICE phase 2 trial assessments.

The SPICE trials can be seen as a response to a statement by Pfleeger et al. (1994) that

Standards have codified approaches whose effectiveness has not been rigorously and scientifically demonstrated. Rather, we have too often relied on anecdote, ‘gut feeling’, the opinions of experts, or even flawed research.

Fenton et al. (1993) and Fenton and Page (1993) have made similar arguments.

The remainder of this paper is organized as follows: Section 2 provides an overview of the ISO/IEC 15504 architecture, Section 3 presents the research method and Section 4 presents the main results of the study and discusses their implications. Finally, Section 5 concludes with a summary of the paper and some final remarks.

## 2. A brief overview of ISO/IEC 15504

### 2.1. Two dimensional architecture

The architecture of the emerging standard ISO/IEC 15504 standard consists of both process and capability dimensions. Fig. 1 shows the structure of the process and capability dimensions.

In the process dimension, the processes associated with software development and maintenance are defined and classified into five categories known as the customer–supplier (CUS), engineering (ENG), support (SUP) Management (MAN), and Organization (ORG) categories. Table 2 gives a brief overview of the five categories and the processes contained in each category.

As shown in Fig. 1 and Table 3, the capability dimension is represented by a set of process attributes (PAs), which can be applied to any process, and represent measurable characteristics required to manage a process and to improve its performance capability. The capability dimension comprises six capability levels ranging from 0 to 5. The higher the level, the higher the process capability.

### 2.2. Capability level determination

An ISO/IEC 15504 assessment is applied to an organizational unit (OU) (El Emam et al., 1998). An OU is the whole or the part of an organization that owns and supports the software process. In this paper the term *organization* will sometimes be used when the term OU would be strictly more correct. During an assessment, an organization can cover only the subset of processes that are relevant for its business objectives. In most cases, it is not necessary to assess all of the processes in the process dimension.

In ISO/IEC 15504, the capability level of each process is determined by rating the PAs. For example, to

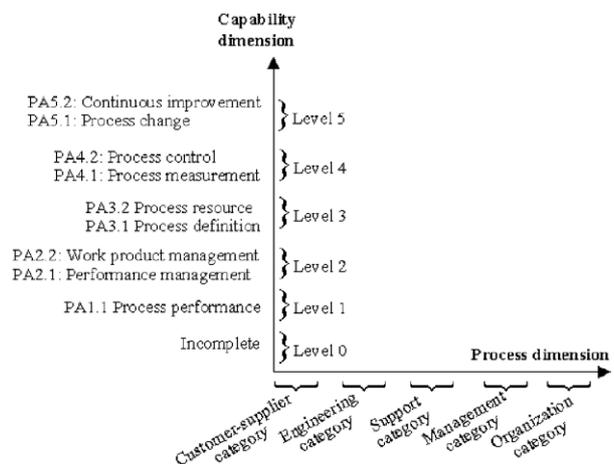


Fig. 1. Two dimensional architecture of ISO/IEC 15504.

متن کامل مقاله

دریافت فوری ←

**ISI**Articles

مرجع مقالات تخصصی ایران

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات