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Knowledge acquisition in information technology and software engineering towards excellence of information systems based on the standardisation platform

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ABSTRACT

This paper presents a study of the collective knowledge in information technology (**IT**) and the comparative analyses of innovative trends in the standardisation of the roads of knowledge in the subfields of software engineering (**SE**).
The focus is on the amount of required innovation that will be necessary in the examples database of standardised units in **IT** and **SE** for the improvement of the information systems (**IS**). The goal is to determine how to obtain appropriate knowledge in **IT** and **SE** to model the excellence of **IS**.
The contribution to the modelling of **IS** excellence in **PDCA** (Plan-Do-Check-Act) is presented.

1. Introduction

The paper investigates standardised collective knowledge in information technology (IT), especially in the subfields of software enginerring (SE) and (information systems) IS. IS is "An *information processing system*, together with associated organisational resources such as human, technical, and financial resources, that provides and distributes *information*" [1] (terms noted in italics are standardised). The term "*collective knowledge*" is defined by standardised term "*knowledge source*" — a source of *information* from which a *knowledge base* has been created for a specific kind of problem [2]. Sources of information for collective knowledge are the ISO/IEC standards (International Organization for Standardization (IScxxO) and the International Electrotechnical Commission (IEC)) [3], SRPS standards (SRPS — designation of standards in Serbia) and sources of information for local knowledge [4]. *Knowledge base* (or K-base or KB) is abbreviated in the vocabulary [1] (01.06.18) and in [2] (28.04.06) – in IT Vocabulary – part 28th, Section 4, term 6. In the present century in IT, we have witnessed the growing problem of continuous improvement in individual knowledge in relation to evolved and standardised knowledge (partly public and collective). One aspect of the problem is *knowledge acquisition*, continuous improvement of the quality of the product (education services), a second is based on *knowledge representation* [1,5], and a third refers to the quantity and value of the required *knowledge engineering*. On a more practical level, according to the International Classification of Standards (ICS) from a population of standards in all areas for ICS-1 (from 1 up to 99), they may include sub/fields such as:

- The evolutions of IT standardisation to E-learning (ICS-3 = 35.240.99), that had not been published previously,
- The evolution of studies of the SE discipline (ICS-2 = 35.080), to IS excellence,
- The future trends defined in boundaries and subfields of IT, SE to IS, as a product.

Today it is not a "problem" to develop IS. Manipulation of information in some integrated IS and creation of "our own" public opinion (including standardisation of design and implementation [6]) is more important. The research presented in this paper relates to the trend analyses of the innovation intensity of *knowledge sources* (KSs) [2] and the required individual knowledge.

Decision-making "problems" based on IS and/or *expert systems* (*ESs*) is not completely new. An ES, is "a *Knowledge-Based System — KBS*, that provides solving problems in a particular domain or application area by drawing *inferences* from a *knowledge base* developed from human

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expertise" [2,1] (*Domain Knowledge* — DK is "*knowledge* accumulated in a particular *domain*" [2]). Comparing collective with individual decision making, the first involves expert knowledge kept in store as the *knowledge base* to solve the "problem" in the domain of the broader collective knowledge. Expanding the applications of SE constantly extends the gap between collective and individual knowledge. The implementation of IS and SE, will make the distance between collective and individual knowledge smaller. The possibilities of applying the excellence model in making management decisions in educational institutions were demonstrated by an implemented information system (in this case, education, as an example).

Historically and evolutionarily, the Japanese interpretation of the "Deming wheel" in Deming's lectures of 1950 and 1951, led to the Plan-Do-Check-Action (PDCA) cyclic quality. This paper presents particularly important and significant aspects of knowledge and experience acquired by the standardised application of SE on the time dimension "t": PtDtCtAt or (PDCA)t quality improvement spiral.

The first results presented in this work, refer to top-down (ICS-2 = 35.080) and the bottom-up (ICS-2 = 35.060) analysis of collective and local knowledge and *knowledge acquisition* in the IT and SE sub/fields. The results are primarily based on ISO/IEC standardisation, as well as on SRPS standards for the implementation, promotion and integration of IS, and they were researched and analysed in parallel.

Classification of the sub-areas of SE applications within IT and related knowledge have exceptional importance, not only for learning and knowledge management, but also for the creation of IS and ES for business decisions. According to the ICS, IT is classified in field 35, with 12 segments. The focus in this work is on the development and SE applications, according to the "collective" (international or global) ISO/IEC [3] in parallel with local SRPS standards, [4] of the ICS-2 = 35.060 and ICS-2 = 35.080 sub-areas:

35.080 — software, Including software development, documentation, Internet applications and use,
35.060 — languages used in information technology etc.

SE (including software development, system documentation and program languages in IT) is important in modelling IS excellence in several dimensions of the software, i.e. strategic, dynamic, temporal, institutional and resource size, as the final product is based on previous design (the product in the form of service).

1.1. To the initial hypotheses and goals of IS excellence through the PDCA

The possibility of reaching the level of collective knowledge is supposed in the starting hypothesis (by support from IT, SE and IS). The ultimate goals of this paper are the creation and continual improvement of knowledge based on standardised units of the knowledge base in SE, in order to model IS excellence. The goals are presented using important evolutionary trends in SE applications from the key results of IS improvement and with given answers to relevant questions, along with the hypothesis (assumption) that there is constant knowledge and IS *acquisition* in the PiDiCiAi (explanation i = ICS&ISO ± SRPS/t, with time dimension "t", where "t" represents year, month, week or day).

Hypothesis 1. Plan($_i$)-phase

H1–P($_i$) or P($_{IT/t}$) In planning the acquisition of knowledge in IT we need significant resources. The resources plan affecting comparative criteria starts from the goals and standardised knowledge, i.e. collective, national, individual or for professional work, to the evolution of the IT profession and then to IS excellence in the improvement of the quality of SE services and solving some practical problems with developed IS. Then, further, with answers to the questions such as, who will (or can they) and how will they plan the resources on the roads of *knowledge acquisition* in the areas of IT/SE (standardised collective — ISO, as a part of the "social" or civilisation domain for some planned results in the local SRPS) in time dimension "t".

Hypothesis 2. Do($_i$)-phase

H2–D($_i$) or D($_{SE/t}$) Paths of knowledge *acquisition* in SE fields are based on global (ISO) and local (SRPS) KS:

- through development activities (from learning, development of standards, *knowledge acquisition* — in the field of SE and IS development),
- to IS modelling excellence using the standardised KB in the time (PtDtCtAt),and
- the size of quantity indices (collective/ISO — local/SRPS) of publications (Iqp$_{/i}$), new projects under development (Iqu$_{/i}$), innovations (Iqi$_{/i}$), for professional work, for improving the quality of IS.

Hypothesis 3. Check($_i$)-phase

H3–C($_i$) or C($_{KB/t}$) Determining the intensity of KS innovation provides new benefits:

- the possibilities of innovation intensity checking of the KB in the time dimension — analysis of the results (realised global activities in the Do($_i$)-phase, with innovation of standardised units of the KB and concrete actions on the continuous improvement of IS and ES), building on the determinants of the critical aspects of knowledge and
- the possibility of anticipating the clusters and necessary resources for updating the KB according to the trends of innovations in the subfields or segments of SE according to the obtained results (quantity indices of innovations — Iqi$_{/i}$, Iqu$_{/i}$, price indices, innovation value indices — Ivi$_{/i}$ or Ivu$_{/i}$) in the PiDiCiAi methodology.

Hypothesis 4. Act($_i$)-phase

H4–A($_i$) or A($_{IS \pm ES/t}$) The possibility of improving the model IS ± ES&PiDiCiAi&QMk exists producting IS excellence, quality and the results of IS applications, starting from the KS, an innovated *data base,* to a new KB (from standardised IT to operational improvement of the integrated IS and ES used in decision making at the university) towards knowledge quality management (QMk). Index "k" refers to the QM key criteria for knowledge acquisition (where k = 1 to 12).

1.1.1. Goals

The aim and purpose of this work is to be of use to higher education institutions, students, faculties, management, and teachers. In addition, since user participation in the standardisation process is becoming more important [6]; the article may be useful to participants who want to develop new standards (innovations) and new degree programmes in SE applications for IS and ES excellence.

The significance of this study lies in determining the period necessary for updating the knowledge base in PDCA (for SE), as well as explicitly defining the criteria which show the limiting possibilities of knowledge innovation, that require appropriate solutions — implicitly. In short, the significance of the research and the study is presented in the "highlights".

2. Related works

The aim of this section is to identify possible related works and to determine the relation between them and research, modelling, development and continuous improvement in their implementation — as shown in this paper. This is achieved through two thematic aspects: "The standardisation of *knowledge acquisition* in IT" (Section 2.1) and "Improving the quality of IS" (Section 2.2). Some partially related research, which does not analyse the development of the software product models (IS) and the methodology of quality improvement – PDCA – and the target path to excellence etc., gives only a partial basis for comparing the