# Information System Examples Software Engineering

Unrivaled coverage of a broad spectrum of industrial engineering concepts and applications The Handbook of Industrial Engineering, Third Edition contains a vast array of timely and useful methodologies for achieving increased productivity, quality, and competitiveness and improving the quality of working life in manufacturing and service industries. This astoundingly comprehensive resource also provides a cohesive structure to the discipline of industrial engineering with four major classifications: technology; performance improvement management; management, planning, and design control; and decision-making methods. Completely updated and expanded to reflect nearly a decade of important developments in the field, this Third Edition features a wealth of new information on project management, supply-chain management and logistics, and systems related to service industries. Other important features of this essential reference include: * More than 1,000 helpful tables, graphs, figures, and formulas * Step-by-step descriptions of hundreds of problem-solving methodologies * Hundreds of clear, easy-to-follow application examples * Contributions from 176 accomplished international professionals with diverse training and affiliations * More than 4,000 citations for further reading The Handbook of Industrial Engineering, Third Edition is an immensely useful one-stop resource for industrial engineers and technical

support personnel in corporations of any size; continuous process and discrete part manufacturing industries; and all types of service industries, from healthcare to hospitality, from retailing to finance. Of related interest . . . HANDBOOK OF HUMAN FACTORS AND ERGONOMICS, Second Edition Edited by Gavriel Salvendy (0-471-11690-4) 2,165 pages 60 chapters "A comprehensive guide that contains practical knowledge and technical background on virtually all aspects of physical, cognitive, and social ergonomics. As such, it can be a valuable source of information for any individual or organization committed to providing competitive, high-quality products and safe, productive work environments."-John F. Smith Jr., Chairman of the Board, Chief Executive Officer and President, General Motors Corporation (From the Foreword) Software engineering requires specialized knowledge of a broad spectrum of topics, including the construction of software and the platforms, applications, and environments in which the software operates as well as an understanding of the people who build and use the software. Offering an authoritative perspective, the two volumes of the Encyclopedia of Software Engineering cover the entire multidisciplinary scope of this important field. More than 200 expert contributors and reviewers from industry and academia across 21 countries provide easy-to-read entries that cover software requirements, design, construction, testing, maintenance, configuration management, quality control, and software engineering management tools and methods. Editor Phillip A. Laplante uses the most universally recognized definition

of the areas of relevance to software engineering, the Software Engineering Body of Knowledge (SWEBOK®), as a template for organizing the material. Also available in an electronic format, this encyclopedia supplies software engineering students, IT professionals, researchers, managers, and scholars with unrivaled coverage of the topics that encompass this ever-changing field. Also Available Online This Taylor & Francis encyclopedia is also available through online subscription, offering a variety of extra benefits for researchers, students, and librarians, including: Citation tracking and alerts Active reference linking Saved searches and marked lists HTML and PDF format options Contact Taylor and Francis for more information or to inquire about subscription options and print/online combination packages. US: (Tel) 1.888.318.2367; (E-mail) e-reference@taylorandfrancis.com International: (Tel) +44 (0) 20 7017 6062; (E-mail) online.sales@tandf.co.uk

Knowledge of scientific and technological developments, and the flexible communication and decision making, knowledge sharing, and collaboration that stem from them, can enable organizations and individuals to be successful and viable competitors in today's global economy. Information Systems and Technology for Organizational Agility, Intelligence, and Resilience aims to advise and support organizational agents who want ensure success in terms of financial, social, and environmental aspects, as well as in the aspect of human development, in a more sustainable way. The premier reference work provides examples of conceptual

research, methodologies, empirical cases, and success cases for academics, researchers, intermediaries, and organizations looking to use information systems and technology to boost their agility, intelligence, and resilience.

The dependence on quality software in all areas of life is what makes software engineering a key discipline for today's society. Thus, over the last few decades it has been increasingly recognized that it is particularly important to demonstrate the value of software engineering methods in real-world environments, a task which is the focus of empirical software engineering. One of the leading protagonists of this discipline worldwide is Prof. Dr. Dr. h.c. Dieter Rombach, who dedicated his entire career to empirical software engineering. For his many important contributions to the field he has received numerous awards and recognitions, including the U.S. National Science Foundation's Presidential Young Investigator Award and the Cross of the Order of Merit of the Federal Republic of Germany. He is a Fellow of both the ACM and the IEEE Computer Society. This book, published in honor of his 60th birthday, is dedicated to Dieter Rombach and his contributions to software engineering in general, as well as to empirical software engineering in particular. This book presents invited contributions from a number of the most internationally renowned software engineering researchers like Victor Basili, Barry Boehm, Manfred Broy, Carlo Ghezzi, Michael Jackson, Leon Osterweil, and, of course, by Dieter Rombach himself. Several key experts from the Fraunhofer IESE, the institute founded and led by Dieter

Rombach, also contributed to the book. The contributions summarize some of the most important trends in software engineering today and outline a vision for the future of the field. The book is structured into three main parts. The first part focuses on the classical foundations of software engineering, such as notations, architecture, and processes, while the second addresses empirical software engineering in particular as the core field of Dieter Rombach's contributions. Finally, the third part discusses a broad vision for the future of software engineering.

In this textbook, Professor van Hee concentrates on discrete dynamic systems, e.g. computer hardware, and information and logistical systems. He develops an integrated formalism which can be used as a prototyping language.

Information systems (IS) are the backbone of any organization today, supporting all major business processes. This book deals with the question: how do these systems come into existence? It gives a comprehensive coverage of managerial, methodological and technological aspects including: Management decisions before and during IS development, acquisition and implementation Project management Requirements engineering and design using UML Implementation, testing and customization Software architecture and platforms Tool support (CASE tools, IDEs, collaboration tools) The book takes into account that for most organizations today, inhouse development is only one of several options to obtain an IS. A good deal of IS development has moved to software vendors – be it

domestic, offshore or multinational software firms. Since an increasing share of this work is done in Asia, Eastern Europe, Latin America and Africa, the making of information systems is discussed within a global context. This Book Is Designed As A Textbook For The First Course In Software Engineering For Undergraduate And Postgraduate Students. This May Also Be Helpful For Software Professionals To Help Them Practice The Software Engineering Concepts.The Second Edition Is An Attempt To Bridge The Gap Between What Is Taught In The Classroom And What Is Practiced In The Industry . The Concepts Are Discussed With The Help Of Real Life Examples And Numerical Problems.This Book Explains The Basic Principles Of Software Engineering In A Clear And Systematic Manner. A Contemporary Approach Is Adopted Throughout The Book. After Introducing The Fundamental Concepts, The Book Presents A Detailed Discussion Of Software Requirements Analysis & Specifications. Various Norms And Models Of Software Project Planning Are Discussed Next, Followed By A Comprehensive Account Of Software Metrics.Suitable Examples, Illustrations, Exercises, Multiple Choice Questions And Answers Are Included Throughout The Book To Facilitate An Easier Understanding Of The Subject.

Covers important concepts, issues, trends, methodologies, and technologies in quality assurance for model-driven software development.

Taking a very practical approach, the author describes in detail database conversion techniques, reverse engineering, forward engineering and re-engineering methodologies for

information systems, offering a systematic software engineering approach for reusing existing database systems built with "old" technology. He demonstrates how the existing systems can be transformed into the new technologies with the preservation of semantic constraints and without loss of information. In this third edition, with a new chapter on Data Normalization the author shows once the databases have been converted, how to integrate them for consolidating information, and how to normalize them so that they are efficient and user friendly. Many examples, illustrations and case studies together with questions and answers ensure that the methodology is easy to follow. Ideal as a textbook for students studying information systems theories, Information Systems Reengineering Integration and Normalization will also be a valuable management reference book for Information Technology Practitioners. Additional material is available on www.extramaterials/978-3-319-12294-6
The subject of this book is the control of software engineering. The rapidly increasing demand for software is accompanied by a growth in the number of products on the market, as well as their size and complexity. Our ability to control software engineering is hardly keeping pace with this growth. As a result, software projects are often late, software products sometimes lack the required quality and the productivity improvements achieved by software engineering are insufficient to keep up with the demand This book describes ways to improve software engineering control. It argues that this should be expanded to include control of the development, maintenance and reuse of software, thus making it possible to apply many of the ideas and concepts that originate in production control and quality control. The book is based on research and experience accumulated over a number of years. During this period I had two employers: Eindhoven University of Technology and Philips Electronics.

Research is not a one-man activity and I would like to thank the following persons for their contributions to the successful completion of this project. First and foremost my Ph. D. advisers Theo Bemelmans, Hans van Vliet and Fred Heemstra whose insights and experience proved invaluable at every stage. Many thanks are also due to Rob Kusters and Fred Heemstra for their patience in listening to my sometimes wild ideas and for being such excellent colleagues.

This book provides guidelines for practicing design science in the fields of information systems and software engineering research. A design process usually iterates over two activities: first designing an artifact that improves something for stakeholders and subsequently empirically investigating the performance of that artifact in its context. This "validation in context" is a key feature of the book - since an artifact is designed for a context, it should also be validated in this context. The book is divided into five parts. Part I discusses the fundamental nature of design science and its artifacts, as well as related design research questions and goals. Part II deals with the design cycle, i.e. the creation, design and validation of artifacts based on requirements and stakeholder goals. To elaborate this further, Part III presents the role of conceptual frameworks and theories in design science. Part IV continues with the empirical cycle to investigate artifacts in context, and presents the different elements of research problem analysis, research setup and data analysis. Finally, Part V deals with the practical application of the empirical cycle by presenting in detail various research methods, including observational case studies, case-based and sample-based experiments and technical action research. These main sections are complemented by two generic checklists, one for the design cycle and one for the empirical cycle. The book is written for students as well as academic and industrial researchers in software engineering or information systems. It

provides guidelines on how to effectively structure research goals, how to analyze research problems concerning design goals and knowledge questions, how to validate artifact designs and how to empirically investigate artifacts in context – and finally how to present the results of the design cycle as a whole.

Software development and information systems design have a unique relationship, but are often discussed and studied independently. However, meticulous software development is vital for the success of an information system. Software Development Techniques for Constructive Information Systems Design focuses the aspects of information systems and software development as a merging process. This reference source pays special attention to the emerging research, trends, and experiences in this area which is bound to enhance the reader's understanding of the growing and ever-adapting field. Academics, researchers, students, and working professionals in this field will benefit from this publication's unique perspective.

This book constitutes the refereed proceedings of the 11th International Conference on Advanced Information Systems Engineering, CAiSE'99 held in Heidelberg, Germany in June 1999. The 27 revised full papers presented together with 12 short research papers and two invited contributions were carefully selected from a total of 168 submissions. The papers are organized in topical sections on components, information systems management, method engineering, data warehouses, process modeling, CORBA and distributed information systems, workflow systems, heterogeneous databases, and information systems dynamics.

Based on their own experiences of in-depth case studies of softwareprojects in international corporations, in this book theauthors present detailed practical guidelines on the preparation,conduct, design and reporting of case studies of

softwareengineering. This is the first software engineering specificbook on the case study research method.

"Information Systems for Business and Beyond introduces the concept of information systems, their use in business, and the larger impact they are having on our world."--BC Campus website.

This book is designed for use as an introductory software engineering course or as a reference for programmers. Up-to-date text uses both theory applications to design reliable, error-free software. Includes a companion CD-ROM with source code third-party software engineering applications.

Computer science graduates often find software engineering knowledge and skills are more in demand after they join the industry. However, given the lecture-based curriculum present in academia, it is not an easy undertaking to deliver industry-standard knowledge and skills in a software engineering classroom as such lectures hardly engage or convince students.

Overcoming Challenges in Software Engineering Education: Delivering Non-Technical Knowledge and Skills combines recent advances and best practices to improve the curriculum of software engineering education. This book is an essential reference source for researchers and educators seeking to bridge the gap between industry expectations and what academia can provide in software engineering education.

The IT community has always struggled with questions concerning the value of an organization's investment in software and hardware. It is the goal of value-based software engineering (VBSE) to develop models and measures of value which are of use for managers, developers and users as they make tradeoff decisions

between, for example, quality and cost or functionality and schedule – such decisions must be economically feasible and comprehensible to the stakeholders with differing value perspectives. VBSE has its roots in work on software engineering economics, pioneered by Barry Boehm in the early 1980s. However, the emergence of a wider scope that defines VBSE is more recent. VBSE extends the merely technical ISO software engineering definition with elements not only from economics, but also from cognitive science, finance, management science, behavioral sciences, and decision sciences, giving rise to a truly multi-disciplinary framework. Biffl and his co-editors invited leading researchers and structured their contributions into three parts, following an introduction into the area by Boehm himself. They first detail the foundations of VBSE, followed by a presentation of state-of-the-art methods and techniques. The third part demonstrates the benefits of VBSE through concrete examples and case studies. This book deviates from the more anecdotal style of many management-oriented software engineering books and so appeals particularly to all readers who are interested in solid foundations for high-level aspects of software engineering decision making, i.e., to product or project managers driven by economics and to software engineering researchers and students.

This book includes a set of rigorously reviewed world-class manuscripts addressing and detailing state-of-the-art research projects in the areas of Computing Sciences, Software Engineering and Systems. The book presents selected papers from the conference

proceedings of the International Conference on Systems,
Computing Sciences and Software Engineering (SCSS
2006). All aspects of the conference were managed on-
line.
Covers central topics in information systems modeling
and architectures. Includes the latest developments in
information systems modeling, methods, and best
practices.
The rapid development of new Information Infrastructure
combined with the increased user needs in specific
areas of Information Technology (mostly related to Web
applications) has created the need for designing new
modeling techniques more innovative and targeted on
specific areas of Information Systems in order to
successfully model the rapidly changed environment,
along with the newly introduced concepts and user
requirements. Therefore, this book aims to introduce
readers to a number of innovative Information modeling
techniques. It is titled "Innovative Information Systems
Modelling Techniques" and includes 9 chapters. The
focus is on the exploration and coverage of the
innovations of recently presented modeling techniques
and their applicability on the Information Systems'
modeling.
Design-type research deals with the multidisciplinary
issues of methodology of design, design principles and
guidelines, and philosophy of design with the aim of
producing knowledge that aids designers in becoming
more effective and efficient. Design-Type Research in
Information Systems: Findings and Practices aims to
demonstrate that Design-Type Research is a legitimate

scientific activity, particularly in the context of the field of Information Systems. Contending that the philosophy, methodology and principles of traditional science also apply to design-type of science, the research contained within this book is important to the widespread acceptance and promotion of design-type research. Readings in Artificial Intelligence and Software Engineering covers the main techniques and application of artificial intelligence and software engineering. The ultimate goal of artificial intelligence applied to software engineering is automatic programming. Automatic programming would allow a user to simply say what is wanted and have a program produced completely automatically. This book is organized into 11 parts encompassing 34 chapters that specifically tackle the topics of deductive synthesis, program transformations, program verification, and programming tutors. The opening parts provide an introduction to the key ideas to the deductive approach, namely the correspondence between theorems and specifications and between constructive proofs and programs. These parts also describes automatic theorem provers whose development has be designed for the programming domain. The subsequent parts present generalized program transformation systems, the problems involved in using natural language input, the features of very high level languages, and the advantages of the programming by example system. Other parts explore the intelligent assistant approach and the significance and relation of programming knowledge in other programming system. The concluding parts focus on the features of the domain

knowledge system and the artificial intelligence programming. Software engineers and designers and computer programmers, as well as researchers in the field of artificial intelligence will find this book invaluable. In 2013, the International Conference on Advance Information Systems Engineering (CAiSE) turns 25. Initially launched in 1989, for all these years the conference has provided a broad forum for researchers working in the area of Information Systems Engineering. To reflect on the work done so far and to examine prospects for future work, the CAiSE Steering Committee decided to present a selection of seminal papers published for the conference during these years and to ask their authors, all prominent researchers in the field, to comment on their work and how it has developed over the years. The scope of the papers selected covers a broad range of topics related to modeling and designing information systems, collecting and managing requirements, and with special attention to how information systems are engineered towards their final development and deployment as software components. With this approach, the book provides not only a historical analysis on how information systems engineering evolved over the years, but also a fascinating social network analysis of the research community. Additionally, many inspiring ideas for future research and new perspectives in this area are sparked by the intriguing comments of the renowned authors. This volume is comprised of the proceedings of the 13th International Conference on Information Systems Development held August 26th-28th, 2004, at Vilnius

Gediminas Technical University, Vilnius, Lithuania. The aim of this volume is to provide a forum for the research and practices addressing current issues associated with Information Systems Development (ISD). Every day, new technologies, applications, and methods raise the standards for the quality of systems expected by organizations as well as end users. All are becoming dependent on systems reliability, scalability, and performance. Thus, it is crucial to exchange ideas and experiences, and to stimulate exploration of new solutions. This proceedings provides a forum for both technical and organizational issues.

In this third edition, the author has arranged the material in five major parts: context, tools, techniques, methods, management and discipline. Within the parts, popular chapters have been retained and updated to reflect modern developments in the area of information systems development. A number of new chapters have been included on such topics as object-oriented analysis and design methods, rapid applications development and business process re-engineering. Each chapter contains a number of case studies illustrating the frameworks, techniques and concepts discussed. A number of exercises are also included to test the understanding of the material. The book will appeal as a core text for first and second level undergarduate students taking information systems development modules on a computer science, computer studies, information systems of business studies course.

Non-Functional Requirements in Software Engineering presents a systematic and pragmatic approach to `building quality into' software systems. Systems must exhibit software quality attributes, such as accuracy, performance, security and modifiability. However, such non-functional requirements (NFRs) are difficult to address in many projects, even though there are many techniques to meet functional requirements in

order to provide desired functionality. This is particularly true since the NFRs for each system typically interact with each other, have a broad impact on the system and may be subjective. To enable developers to systematically deal with a system's diverse NFRs, this book presents the NFR Framework. Structured graphical facilities are offered for stating NFRs and managing them by refining and inter-relating NFRs, justifying decisions, and determining their impact. Since NFRs might not be absolutely achieved, they may simply be satisfied sufficiently (`satisficed'). To reflect this, NFRs are represented as `softgoals', whose interdependencies, such as tradeoffs and synergy, are captured in graphs. The impact of decisions is qualitatively propagated through the graph to determine how well a chosen target system satisfices its NFRs. Throughout development, developers direct the process, using their expertise while being aided by catalogues of knowledge about NFRs, development techniques and tradeoffs, which can all be explored, reused and customized. Non-Functional Requirements in Software Engineering demonstrates the applicability of the NFR Framework to a variety of NFRs, domains, system characteristics and application areas. This will help readers apply the Framework to NFRs and domains of particular interest to them. Detailed treatments of particular NFRs - accuracy, security and performance requirements - along with treatments of NFRs for information systems are presented as specializations of the NFR Framework. Case studies of NFRs for a variety of information systems include credit card and administrative systems. The use of the Framework for particular application areas is illustrated for software architecture as well as enterprise modelling. Feedback from domain experts in industry and government provides an initial evaluation of the Framework and some case studies. Drawing on research results from several

theses and refereed papers, this book's presentation, terminology and graphical notation have been integrated and illustrated with many figures. Non-Functional Requirements in Software Engineering is an excellent resource for software engineering practitioners, researchers and students. This Concise Encyclopedia of Software Engineering is intended to provide compact coverage of the knowledge relevant to the practicing software engineer. The content has been chosen to provide an introduction to the theory and techniques relevant to the software of a broad class of computer applications. It is supported by examples of particular applications and their enabling technologies. This Encyclopedia will be of value to new practitioners who need a concise overview and established practitioners who need to read about the "penumbra" surrounding their own specialities. It will also be useful to professionals from other disciplines who need to gain some understanding of the various aspects of software engineering which underpin complex information and control systems, and the thinking behind them. This book summarizes the research findings presented at the 13th International Joint Conference on Knowledge-Based Software Engineering (JCKBSE 2020), which took place on August 24–26, 2020. JCKBSE 2020 was originally planned to take place in Larnaca, Cyprus. Unfortunately, the COVID-19 pandemic forced it be rescheduled as an online conference. JCKBSE is a well-established, international, biennial conference that focuses on the applications of artificial intelligence in software engineering. The 2020 edition of the conference was organized by Hiroyuki Nakagawa, Graduate School of Information Science and Technology, Osaka University, Japan, and George A. Tsihrintzis and Maria Virvou, Department of Informatics, University of Piraeus, Greece. This research book is a valuable resource for experts and researchers in the field of (knowledge-based) software

engineering, as well as general readers in the fields of
artificial and computational Intelligence and, more generally,
computer science wanting to learn more about the field of
(knowledge-based) software engineering and its applications.
An extensive list of bibliographic references at the end of
each paper helps readers to probe further into the application
areas of interest to them.
This volume aims to pave the way to a greater understanding
of the information system development process. Traditionally,
information systems have been perceived as a slice of real
world history. This has led to a strong emphasis on the
development of conceptual models, the requirements
specifications of which can readily be expressed. However,
the route to such an expression, or the process of
development, has not received any substantial attention. It is
now agreed that a study of the development process affords
notable benefits. Firstly, it helps to create an understanding of
what a realistic development process is and how it proceeds
from an initial specification to its acceptable representation.
Secondly, the nature of guidance that can be provided by the
next generation of CASE tools can be substantially improved.
It can be expected that these tools will cease to be mere
drafting aids and consistency checking programs. Instead it is
likely that they will provide a procreative environment in which
the development engineer will play an important role. This
tool/user symbiosis should have a beneficial impact on both
the productivity of the developer and on the quality of the
product. In bringing together researchers and practitioners
from such diverse areas as AI, Software Engineering,
Decision Support and Information Systems, it is hoped this
publication will take the quest to comprehend information
system development processes a significant step forwards.
Method Engineering focuses on the design, construction and
evaluation of methods, techniques and support tools for

information systems development It addresses a number of important topics, including: method representation formalisms; meta-modelling; situational methods; contingency approaches; system development practices of method engineering; terminology and reference models; ontologies; usability and experience reports; and organisational support and impact.

"This book provides an overview of useful techniques in artificial intelligence for future software development along with critical assessment for further advancement"--Provided by publisher.

This book contains the collection of full papers accepted at the 11th International Conference on Enterprise Information Systems (ICEIS 2009), organized by the Ins- tute for Systems and Technologies of Information Control and Communication (INSTICC) in cooperation with the Association for Advancement of Artificial Intel- gence (AAAI) and ACM SIGMIS (SIG on Management Information Systems), and technically co-sponsored by the Japanese IEICE SWIM (SIG on Software Interprise Modeling) and the Workflow Management Coalition (WfMC). ICEIS 2009 was held in Milan, Italy. This conference has grown to become a - jor point of contact between research scientists, engineers and practitioners in the area of business applications of information systems. This year, five simultaneous tracks were held, covering different aspects related to enterprise computing, including: "- tabases and Information Systems Integration," "Artificial Intelligence and Decision Support Systems," "Information Systems Analysis and Specification," "Software Agents and Internet Computing" and "Human–Computer Interaction". All tracks describe research work that is often oriented toward real-world applications and hi- light the benefits of information systems and technology for industry and services, thus making a bridge between

academia and enterprise. ICEIS 2009 received 644 paper submissions from 70 countries in all continents; 81 papers were published and presented as full papers, i.e., completed research work (8 pages/30-minute oral presentation). Additional papers accepted at ICEIS, including short papers and posters, were published in the regular conference proceedings.

This book constitutes the thoroughly refereed post-conference proceedings of the 4th IFIP TC2 Central and East European Conference on Software Engineering Techniques, CEE-SET 2009, held in Krakow, Poland, in October 2009. The 19 revised full papers presented were carefully reviewed and selected from 63 submissions. The papers are organized in topical sections on software architectures and development; modelling and formal methods in software development; measurements, testing, and quality of software.

This book constitutes the refereed proceedings of the First International Conference on Fundamental Approaches to Software Engineering, FASE'98, held as part of the Joint European Conferences on Theory and Practice of Software, ETAPS'98, held in Lisbon, Portugal, in March/April 1998. Besides two invited presentations and three system demonstrations, this volume presents 18 revised full papers selected from a total of 59 submissions. Among the various fundamental software engineering issues addressed are formal methods, specification languages, refinement, object-oriented modeling, software architectures, statecharts, model checking, etc.

Businesses must constantly adapt to a dynamically changing environment that requires choosing an adaptive and dynamic information architecture that has the flexibility to support both changes in the business environment and changes in technology. In general, information systems reengineering has the objective of extracting the contents, data structures,

and flow of data and process contained within existing legacy systems in order to reconstitute them into a new form for subsequent implementation. Information Systems Reengineering for Modern Business Systems: ERP, Supply Chain and E-Commerce Management Solutions covers different techniques that could be used in industry in order to reengineer business processes and legacy systems into more flexible systems capable of supporting modern trends such as Enterprise Resource Planning (ERP), supply chain management systems and e-commerce. This reference book also covers other issues related to the reengineering of legacy systems, which include risk management and obsolescence management of requirements.

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