Software Engineering And Quality Assurance

An in-depth review of key techniques in software error detection Software error detection is one of the most challenging problems in software engineering. Now, you can learn how to make the most of software testing by selecting test cases to maximize the probability of revealing latent errors. Software Error Detection through Testing and Analysis begins with a thorough discussion of test-case selection and a review of the concepts, notations, and principles used in the book. Next, it covers: Code-based test-case selection methods Specification-based test-case selection methods Additional advanced topics in testing Analysis of symbolic trace Static analysis Program instrumentation Each chapter begins with a clear introduction and ends with exercises for readers to test their understanding of the material. Plus, appendices provide a logico-mathematical background, glossary, and questions for self-assessment. Assuming a basic background in software quality assurance and an ability to write nontrivial programs, the book is free of programming languages and paradigms used to construct the program under test. Software Error Detection through Testing and Analysis is suitable as a professional reference for software testing specialists, software engineers, software developers, and software programmers. It is also appropriate as a textbook for software engineering, software testing, and software quality assurance courses at the advanced undergraduate and graduate levels.

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

Software is important because it is used by a great many people in companies and institutions. This book presents engineering methods for designing and building software. Based on the author's experience in software engineering as a programmer in the defense and aerospace industries, this book explains how to ensure a software that is programmed operates according to its requirements. It also shows how to develop, operate, and maintain software engineering capabilities by instilling an engineering discipline to support programming, design, builds, and delivery to customers. This book helps software engineers to: Understand the basic concepts, standards, and requirements of software engineering. Select the appropriate programming and design techniques. Effectively use software engineering tools and applications. Create specifications to comply with the software standards and requirements. Utilize various methods and techniques to identify defects. Manage changes to standards and requirements. Besides providing a technical view, this book discusses the moral and ethical responsibility of software engineers to ensure that the software they design and program does not cause serious problems. Software engineers tend to be concerned with the technical elegance of their software products and tools, whereas customers tend to be concerned only with whether a software product meets their needs and is easy and ready to use. This book looks at these two sides of software development and the challenges they present for software engineering. A critical understanding of software engineering empowers developers to choose the right methods for achieving effective results. Effective Methods for Software Engineering guides software programmers and developers to develop this critical understanding that is so crucial in today's software-dependent society.

The one resource needed to create reliable software This text offers a comprehensive and integrated approach tosoftware quality engineering. By following the author's clearguidance, readers learn how to master the techniques to producehigh-quality, reliable software, regardless of the softwaresystem's level of complexity. The first part of the publication introduces major topics insoftware quality engineering and presents quality planning as anintegral part of the process. Providing readers with a solidfoundation in key concepts and practices, the book moves on tooffer in-depth coverage of software testing as a primary means toensure software quality; alternatives for quality assurance,including defect prevention, process improvement, inspection,formal verification, fault tolerance, safety assurance, and damagecontrol; and measurement and analysis to close the feedback loopfor quality assessment and quantifiable improvement. The text's approach and style evolved from the author's hands-onexperience in the classroom. All the pedagogical tools needed tofacilitate quick learning are provided: * Figures and tables that clarify concepts and provide quick topicsummaries * Examples that illustrate how theory is applied in real-worldsituations * Comprehensive bibliography that leads to in-depth discussion ofspecialized topics * Problem sets at the end of each chapter that test readers'knowledge This is a superior textbook for software engineering, computerscience, information systems, and electrical engineering students,and a dependable reference for software and computer professionalsand engineers.

' Software systems surround us. Software is a critical component in everything from the family car through electrical power systems to military equipment. As software plays an ever-increasing role in our lives and livelihoods, the quality of that software becomes more and more critical. However, our ability to deliver high-quality software has not kept up with those increasing demands. The economic fallout is enormous; the US economy alone is losing over US$50 billion per year due to software failures. This book presents new research into using advanced artificial intelligence techniques to guide software quality improvements. The techniques of chaos theory and data mining are brought to bear to provide new insights into the software development process. Written for researchers and practitioners in software engineering and computational intelligence, this book is a unique and important bridge between these two fields. Contents:Software Engineering and Artificial IntelligenceSoftware Testing and Artificial IntelligenceChaos Theory and Software ReliabilityData Mining and Software MetricsSkewness and Resampling Readership: Primarily, researchers working in the areas of software quality assurance or in computational intelligence, and particularly those interested in interdisciplinary research between these two topics. The book is also intended for practicing software engineers interested in the use of novel technologies for software quality engineering. In addition, the book is appropriate for an advanced graduate-level course in computational intelligence or software engineering. Keywords:Computational Intelligence;Data Mining;Pattern Recognition;Chaos Theory;Software Engineering;Software Reliability;Software Quality AssuranceKey Features:Extensive bibliography of over 300 references, covering the intersection of software engineering and computational intelligence, as well as background material in each fieldUnique usage of chaos theory in software reliability modelingNovel approaches to software quality assurance using data miningReviews of software engineering and computational intelligence make the book self-containedReviews:"Written for researchers and practitioners in software engineering and computational intelligence, this book is a unique and important bridge between these two fields."Zentralblatt MATH '

Driving innovation can reduce costs for companies, institutions, military programs, and successful businesses. Quality is key to successful innovation. Delivery of complex products must have high quality to reduce customer problems and defects. This book explains how to integrate Quality Assurance processes to produce compliant product management and gap analysis. It shows

how Quality Assurance provides a common operating framework in which best practices, improvements, and cost avoidance activities can be shared. Effective Processes for Quality Assurance emphasizes improving process execution and reducing operational costs. It also focuses on how Quality Assurance personnel must support companies, institutions, military programs, and successful businesses by encouraging a cooperative, proactive approach and ensure compliance through management and team member participation. Lean and Agile can provide a competitive advantage, and this practical reference explains how to implement these two principles to deliver products that have fewer defects. It also explains: Quality Assurance methods Measuring benefits of Quality Assurance process improvement Quality Assurance performance and improvement Risk management Quality Assurance improvement with metrics Effective processes for Quality Assurance Quantitative process performance and commitments Quality Assurance plans Quality Assurance for customers and suppliers Supporting software configuration Effective Processes for Quality Assurance covers the critical issues for implementing Quality Assurance processes that can deliver high-quality products successfully.

During the 18 months since the publication of the 1st edition the practice of software quality and the availability of tools and guidance for its implementation has increased dramatically. The emphasis on the need for formal methods has increased and calls for certification of safety critical software are now common. In particular this 2nd edition: -Expands the treatment of static analysis and includes a com prehensive but simple example in order to illustrate clearly the functions of each analyser in Chapter 8. -Describes formal requirements languages more fully in Chapter 6. -Updates the compendium of available guidelines and standards in Chapter 5. -Expands the description of the many high level languages in Chapter 9. -Improves and expands the exercise into a 49 page case study consisting of a documentation hierarchy for a safety system in Chapter 14. It is seeded with deliberate errors and ambiguities and now includes guidance in finding them.

Presenting the state of the art in component-based software testing, this cutting-edge resource offers you an in-depth understanding of the current issues, challenges, needs and solutions in this critical area. The book discusses the very latest advances in component-based testing and quality assurance in an accessible tutorial format, making the material easy to comprehend and benefit from no matter what your professional level. important, and how it differs from traditional software testing. From an introduction to software components, testing component-based software and validation methods for software components, to performance testing and measurement, standards and certification and verification of quality for component-based systems, you get a revealing snapshot of the key developments in this area, including important research findings. This volume also serves as a textbook for related courses at the advanced undergraduate or graduate level.

"This book provides the research and instruction used to develop and implement software quickly, in small iteration cycles, and in close cooperation with the customer in an adaptive way, making it possible to react to changes set by the constant changing business environment. It presents four values explaining extreme programming (XP), the most widely adopted agile methodology"--Provided by publisher.

This book comprehensively covers the ISO 9000-3 requirements. IT also provides a substantial portion of the body of knowledge required for the CSQE (Certified Software Quality Engineer) as outlined by the ASQ (American Quality Engineer) as outlined by the ASQ (American Society for Quality).

A superior primer on software testing and quality assurance, from integration to execution and automation This important new work fills the pressing need for a user-friendly text that aims to provide software engineers, software quality professionals, software developers, and students with the fundamental developments in testing theory and common testing practices. Software Testing and Quality Assurance: Theory and Practice equips readers with a solid understanding of: Practices that support the production of quality software Software testing techniques Life-cycle models for requirements, defects, test cases, and test results Process models for units, integration, system, and acceptance testing How to build test teams, including recruiting and retaining test engineers Quality Models, Capability Maturity Model, Testing Maturity Model, and Test Process Improvement Model Expertly balancing theory with practice, and complemented with an abundance of pedagogical tools, including test questions, examples, teaching suggestions, and chapter summaries, this book is a valuable, self-contained tool for professionals and an ideal introductory text for courses in software testing, quality assurance, and software engineering.

This book constitutes the refereed proceedings of the 9th Software Quality Days Conference, SWQD 2017, held in Vienna, Austria, in January 2017. The SWQD conference offers a range of comprehensive and valuable information by presenting new ideas from the latest research papers, keynote speeches by renowned academics and industry leaders, professional lectures, exhibits, and tutorials. The 4 full papers and 7 short papers presented in this volume were carefully reviewed and selected from 21 submissions. They were organized in topical sections named: model-driven development and configuration management; software development and quality assurance; software quality assurance in industry; crowdsourcing in software engineering; software testing and traceability; and process improvement. The book also contains one keynote talk in full paper length.

From the basics to the most advanced quality of service (QoS) concepts, this all encompassing, first-of-its-kind book offers an in-depth understanding of the latest technical issues raised by the emergence of new types, classes and qualities of Internet services. The book provides end-to-end QoS guidance for real time multimedia communications over the Internet. It offers you a multiplicity of hands-on examples and simulation script support, and shows you where and when it is preferable to use these techniques for QoS support in networks and Internet traffic with widely varying characteristics and demand profiles. This practical resource discusses key standards and protocols, including real-time transport, resource reservation, and integrated and differentiated service models, policy based management, and mobile/wireless QoS. The book features numerous examples, simulation results and graphs that illustrate important concepts, and pseudo codes are used to explain algorithms. Case studies, based on freely available Linux/FreeBSD systems, are presented to show you how to build networks supporting Quality of Service. Online support material including presentation foils, lab exercises and additional exercises are available to text adopters.

The most comprehensive General, Organic, and Biochemistry book available, Introduction to General, Organic, and Biochemistry, 11th Edition continues its tradition of a solid development of problem-solving skills, numerous examples and practice problems, along with coverage of current applications. Written by an experienced author team, they skillfully anticipate areas of difficulty and pace the book accordingly. Readers will find the right mix of general chemistry compared to the discussions on organic and biochemistry. Introduction to General, Organic, and Biochemistry, 11th Edition has clear & logical explanations of chemical concepts and great depth of coverage as well as a clear, consistent writing style which provides great readability. An emphasis on Real-World aspects of chemistry makes the reader comfortable in seeing how the chemistry will apply to their career.

Software Quality. Complexity and Challenges of Software Engineering in Emerging Technologies9th International Conference, SWQD 2017, Vienna, Austria, January 17-20, 2017, ProceedingsSpringer

This work examines software quality assurance in practice and includes standards and models.

""This is the single best book on software quality engineering and metrics that I've encountered."" --Capers Jones, from the Foreword"Metrics and Models in Software Quality Engineering, Second Edition," is

the definitive book on this essential topic of software development. Comprehensive in scope with extensive industry examples, it shows how to measure software quality and use measurements to improve the software development process. Four major categories of quality metrics and models are addressed: quality management, software reliability and projection, complexity, and customer view. In addition, the book discusses the fundamentals of measurement theory, specific quality metrics and tools, and methods for applying metrics to the software development process.New chapters bring coverage of critical topics, including: In-process metrics for software testingMetrics for object-oriented software developmentAvailability metricsMethods for conducting in-process quality assessments and software project assessmentsDos and Don'ts of Software Process Improvement, by Patrick O'TooleUsing Function Point Metrics to Measure Software Process Improvement, by Capers Jones In addition to the excellent balance of theory, techniques, and examples, this book is highly instructive and practical, covering one of the most important topics in software development--quality engineering. 0201729156B08282002 Software Systems are now everywhere. Almost all electrical equipment now includes some kind of software; software is used to help run manufacturing, schools and universities, healthcare, finance and government; many people use different types of software for entertainment and education. The specification, development, management and development of these software systems constitute the discipline of software engineering. Even simple software systems have a high inherent complexity, so engineering principles must be used in their development. Therefore, software engineering is an engineering discipline, and software engineers use computer science methods and theories, and apply this in a cost-effective way to solve problems. These difficult problems mean that many software development projects have not been successful. However, most modern software provides users with good service; we should not let high-profile failures blur the true success of software engineers over the past 30 years. Software engineering w s developed to address the issue of building large custom software systems for defines, government, and industrial applications. We are now developing a wider range of software, from games on professional consoles to PC products and network-based systems to large-scale distributed systems. While some technologies for custom systems, such as object-oriented development, are common, new software engineering technologies are being developed for different types of software. It's impossible to cover everything in a book, so we focus on developing common technologies and technologies for large systems rather than individual software products. Although this book is intended as a general introduction to software engineering, it is geared toward system requirements engineering. We think this is especially important for software engineering in the 21st century. The challenge we face is to ensure that our software meets the actual needs of users without damaging them or the environment. The approach we take in this book is to present a broad perspective on software engineering, and we won't focus on any particular method or tool. There are no simple solutions to software engineering problems, and we need a wide range of tools and techniques to solve software engineering problems.

Intended for both undergraduate and postgraduate students of computer science and engineering, information technology, students of computer applications, and working IT professionals, this text describes the practices necessary for the development of quality software. The contents of the book have been framed based on the syllabi prescribed by different Universities and also covers the topics required for working in the IT industry. Based on the experience of the author in the industry, academics, consultancy and corporate trainings in India and abroad, the book covers the methodologies, techniques, and underlying concepts used in Software Quality Assurance and Testing. The treatment of the topics is crisp and accompanied with illustrative examples with minimum jargons. Topics of relevance in the industry, which a student must be familiar with before start of a career, are covered in the book. The book also discusses the concepts that a working IT professional should know. The book provides an insight into the tools available for different types of testing. Each chapter contains Quizzes, Multiple Choice Questions and Review Questions which help the readers to qualify in the international certification examinations. Key features • Covers topics relevant to the industry • Concepts discussed in an easy to understand way and illustrated with practical examples and figures wherever required • Contains "Objective Questions" at the end of the book • Includes topics prescribed in international certification exams in Software Quality and Testing

This book constitutes the refereed proceedings of the 12th Software Quality Days Conference, SWQD 2020, held in Vienna, Austria, in January 2020. The Software Quality Days (SWQD) conference started in 2009 and has grown to the biggest conference on software quality in Europe with a strong community. The program of the SWQD conference is designed to encompass a stimulating mixture of practical presentations and new research topics in scientific presentations. The guiding conference topic of the SWQD 2020 is "Quality Intelligence in Software and Systems Engineering". The 5 full papers and 2 short papers presented in this volume were carefully reviewed and selected from 17 submissions. The volume also contains 2 invited talks. The contributions were organized in topical sections named: industry challenges and collaborations; software testing approaches; social aspects in software engineering; natural language processing; and software quality assurance concepts.

This comprehensive reference on software development quality assurance addresses all four dimensions of quality: specifications, design, construction and conformance. It focuses on quality from both the micro and macro view. From a micro view, it details the aspect of building-in quality at the component level to help ensure that the overall deliverable has ingrained quality. From a macro view, it addresses the organizational level activities that provide an environment conducive to fostering quality in the deliverables as well as developing a culture focused on quality in the organization. Mastering Software Quality Assurance also explores a process driven approach to quality, and provides the information and guidance needed for implementing a process quality model in your organization. It includes best practices and valuable tools and techniques for software developers.Key Features • Provides a comprehensive, inclusive view of software quality • Tackles the four dimensions of quality as applicable to software development organizations • Offers unique insights into achieving quality at the component level • Deals comprehensively with all aspects of measuring software quality • Explores process quality from the standpoint of implementation rather than from the appraiser/assessor point of view • Delivers a bird's eye view of the ISO and CMMI models, and describes necessary steps for attaining conformance to those models

This textbook offers undergraduate students an introduction to the main principles and some of the most popular techniques that constitute 'software quality assurance'. The book seeks to engage students by placing an emphasis on the underlying foundations of modern quality-assurance techniques , using these to highlight why techniques work, as opposed to merely focussing on how they work. In doing so it provides readers with a comprehensive understanding of where software quality fits into the development lifecycle (spoiler: everywhere), and what the key quality assurance activities are. The book focuses on quality assurance in a way that typical, more generic software engineering reference books do not. It is structured so that it can (and should) be read from cover to cover throughout the course of a typical university module. Specifically, it is Concise: it is small enough to be readable in its entirety over the course of a typical software engineering module. Explanatory: topics are discussed not merely in terms of what they are, but also why they are the way they are – what events, technologies, and individuals or organisations helped to shape them into what they are now. Applied: topics are covered with a view to giving the reader a good idea of how they can be applied in practice, and by pointing, where possible, to evidence of their efficacy. The book starts from some of the most general notions (e.g. quality and development process), and gradually homes-in on the more specific activities, assuming knowledge of the basic notions established in prior

chapters. Each chapter concludes with a "Key Points" section, summarising the main issues that have been covered in the chapter. Throughout the book there are exercises that serve to remind readers of relevant parts in the book that have been covered previously, and give them the opportunity to reflect on a particular topic and refer to related references.

Quality is not a fixed or universal property of software; it depends on the context and goals of its stakeholders. Hence, when you want to develop a high-quality software system, the first step must be a clear and precise specification of quality. Yet even if you get it right and complete, you can be sure that it will become invalid over time. So the only solution is continuous quality control: the steady and explicit evaluation of a product's properties with respect to its updated quality goals. This book guides you in setting up and running continuous quality control in your environment. Starting with a general introduction on the notion of quality, it elaborates what the differences between process and product quality are and provides definitions for quality-related terms often used without the required level of precision. On this basis, the work then discusses quality models as the foundation of quality control, explaining how to plan desired product qualities and how to ensure they are delivered throughout the entire lifecycle. Next it presents the main concepts and techniques of continuous quality control, discussing the quality control loop and its main techniques such as reviews or testing. In addition to sample scenarios in all chapters, the book is rounded out by a dedicated chapter highlighting several applications of different subsets of the presented quality control techniques in an industrial setting. The book is primarily intended for practitioners working in software engineering or quality assurance, who will benefit by learning how to improve their current processes, how to plan for quality, and how to apply state-of-the-art quality control techniques. Students and lecturers in computer science and specializing in software engineering will also profit from this book, which they can use in practice-oriented courses on software quality, software maintenance and quality assurance.

This technical report documents the joint activities in the context of the cooperation between the Thammasat University, Department of Computer Science (Bangkok, Thailand) and the Beuth Hochschule f ur Technik, Department for Informatics and Media (Berlin, Germany). The main focus is on software engineering, IT project management and quality assurance. The report contains the following contributions: Extending Platform Independent Model with Security Features (Nattakan Suppajak, Songsakdi Rongviriyapanish) Development of a General Rule-Set for Human Computer Interaction Patterns (Kirsten Westphal, Roland Petrasch) Model Based User Interface Development and HCI Patterns: The Registration-Pattern as an Example (Roland Petrasch) Productivity and Maintainability in Extreme Programming and Waterfall-based Projects (Charinya Klakhang, Songsakdi Rongviriyapanish, Taweesup Apiwattanapong) * Model-Driven Software Development with Xtext (Max Goltzsche)

Software Quality Assurance in Large Scale and Complex Software-intensive Systems presents novel and high-quality research related approaches that relate the quality of software architecture to system requirements, system architecture and enterprise-architecture, or software testing. Modern software has become complex and adaptable due to the emergence of globalization and new software technologies, devices and networks. These changes challenge both traditional software quality assurance techniques and software engineers to ensure software quality when building today (and tomorrow's) adaptive, context-sensitive, and highly diverse applications. This edited volume presents state of the art techniques, methodologies, tools, best practices and guidelines for software quality assurance and offers guidance for future software engineering research and practice. Each contributed chapter considers the practical application of the topic through case studies, experiments, empirical validation, or systematic comparisons with other approaches already in practice. Topics of interest include, but are not limited, to: quality attributes of system/software architectures; aligning enterprise, system, and software architecture from the point of view of total quality; design decisions and their influence on the quality of system/software architecture; methods and processes for evaluating architecture quality; quality assessment of legacy systems and third party applications; lessons learned and empirical validation of theories and frameworks on architectural quality; empirical validation and testing for assessing architecture quality. Focused on quality assurance at all levels of software design and development Covers domain-specific software quality assurance issues e.g. for cloud, mobile, security, context-sensitive, mash-up and autonomic systems Explains likely trade-offs from design decisions in the context of complex software system engineering and quality assurance Includes practical case studies of software quality assurance for complex, adaptive and context-critical systems

Software Quality Assurance (SQA) as a professional domain is becoming increasingly important. This book provides practical insight into the topic of Software Quality Assurance. It covers discussion on the importance of software quality assurance in the business of Information Technology, covers key practices like Reviews, Verification & Validation. It also discusses people issues and other barriers in successful implementatin of Quality Management Systems in organization. This work presents methodologies, concepts as well as practical scenarios while deploying Quality Assurance practices and integrates the underlying principle into a complete reference book on this topic. -- Publisher description.

The industry's top guide to software quality -- completely updated! Practical techniques for mission-critical and commercial software. Build a great software quality organization. Prepare for ASQ Software Quality Engineer Certification. Software quality assurance has never been more challenging -- nor more business-critical. In this completely updated guide, sixteen of the world's leading SQA experts share their practical experience with the full range of techniques available for managing software quality. Discover the best ways to organize, staff and improve your software quality organization. Learn how to make the most of inspections, software configuration management, Pareto charts, metrics, statistical methods, CASE tools and other key SQA tools and approaches. "Handbook of Software Quality Assurance, Third Edition "shows you how to: Hire the right software

quality professionals -- and get the best from them Structure your software quality program for maximum effectiveness Understand the role of software quality assurance in supporting the SEI Capability Maturity Model Leverage proven quality techniques from other fields Learn today's best practices for managing SQA in commercial software, customized mission-critical software, and embedded systems. Master the specialized techniques, standards, guidelines and rules for managing software safety, and walk through a state-of-the-art SQA case study at Boeing Space Transportation's Systems Software organization. Whether you're a software developer or customer, if you want more reliable software, this end-to-end guide will help you get it.

Computer software, Computers, Data processing, Software engineering techniques, Quality assurance, Quality control, Reliability, Data security, Product design, Maintainability

This volume presents the thoroughly revised proceedings of the ICSE '94 Workshop on Joint Research Issues in Software Engineering and Human-Computer Interaction, held in Sorrento, Italy in May 1994. In harmony with the main objectives of the Workshop, this book essentially contributes to establishing a sound common platform for exchange and cooperation among researchers and design professionals from the SE and HCI communities. The book includes survey papers by leading experts as well as focused submitted papers. Among the topics covered are design, processes, user interface technology and SE environments, platform independence, prototyping, interactive behaviour, CSCW, and others.

Market_Desc: Students and instructors of software engineering, as well as practitioners of software testing. Special Features: · Balances theoretical ideas with practical explanations.· An excellent professional reference and outstanding teaching tool with example programs used in automating test executions, test questions, examples, teaching suggestions, chapter summaries, further reading, and a solutions manual. About The Book: Topics covered include: key concepts in software quality assurance (SQA), SQA processes and metrics; the role of testing; basics of program testing; theory of program testing; code review; unit testing; test generation from control flow graphs, data flow graphs, and program domains; system integration; system testing; test execution; test automation; acceptance testing; quality metrics and reliability models.

A thoroughly revised and expanded new edition that devotes more space to the use of metrics in planning, monitoring and controlling the software development process, as well as for the certification of the product. A text for students and professionals; exercises are included.

This book constitutes the refereed proceedings of the 13th Software Quality Days Conference, SWQD 2021, which was planned to be held in Vienna, Austria, during January 19–21, 2021. Due to the COVID-19 pandemic, the conference was cancelled and will be merged with SWQD 2022. The Software Quality Days (SWQD) conference started in 2009 and has grown to the biggest conference on software quality in Europe with a strong community. The program of the SWQD conference is designed to encompass a stimulating mixture of practical presentations and new research topics in scientific presentations. The guiding conference topic of the SWQD 2021 is "Future Perspectives on Software Engineering Quality". The 3 full papers and 5 short papers presented in this volume were carefully reviewed and selected from 13 submissions. The volume also contains 2 invited talks and one introductory paper for an interactive session. The contributions were organized in topical sections named: automation in software engineering; quality assurance for AI-based systems; machine learning applications; industry-academia collaboration; and experimentation in software engineering.