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## Studying the benefits of using UML on software maintenance : an evidence-based approach

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# BIBLIOGRAPHY

- Abbes, M., Khomh, F., Gueheneuc, Y.-G., and Antoniol, G. (2011). An empirical study of the impact of two antipatterns, blob and spaghetti code, on program comprehension. In *Proceedings of the European Conference on Software Maintenance and Reengineering (CSMR'11)*, pp. 181–190.
- Abrial, J.R. (1996). *The B-Book* (Cambridge University Press).
- Agner, L.T.W., Soares, I.W., Stadzisz, P.C., and Simão, J.M. (2013). A Brazilian survey on UML and model-driven practices for embedded software development. *Journal of Systems and Software* 86, 997–1005.
- Anda, B., Hansen, K., Gullisen, I., and Thorsen, H.K. (2006). Experiences from introducing UML-based development in a large safety-critical project. *Empirical Software Engineering* 11, 555–581.
- Arisholm, E., and Briand, L.C. (2006). Predicting fault-prone components in a java legacy system. In *Proceedings of the 2006 ACM/IEEE International Symposium on Empirical Software Engineering (ISESE'06)*, (New York, NY, USA: ACM), pp. 8–17.
- Arisholm, E., Briand, L.C., Hove, S.E., and Labiche, Y. (2006). The impact of UML documentation on software maintenance: an experimental evaluation. *IEEE Transactions on Software Engineering* 32, 365–381.
- Arksey, H., and O'Malley, L. (2005). Scoping studies: towards a methodological framework. *International Journal of Social Research Methodology* 8, 19–32.
- Aseniero, B.A., Wun, T., Ledo, D., Ruhe, G., Tang, A., and Carpendale, S. (2015). STRATOS: Using visualization to support decisions in strategic software release planning. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems (CHI'15)*, (New York, NY, USA: ACM), pp. 1479–1488.
- Atkinson, C., and Kühne, T. (2003). Model-driven development: a metamodeling foundation. *IEEE Software* 20, 36–41.
- Basili, V., and Weiss, D. (1984). A methodology for collecting valid software engineering data. *IEEE Transactions on Software Engineering* 10, 728–738.
- Basili, V.R., and Rombach, H.D. (1988). The TAME project: towards improvement-oriented software environments. *IEEE Transactions on Software Engineering* 14, 758–773.
- Basili, V., Shull, F., and Lanubile, F. (1999). Building knowledge through families of experiments. *IEEE Transactions on Software Engineering* 25, 456–473.
- Berenbach, B., and Konrad, S. (2007). Putting the “engineering” into software engineering with models. In *Proceedings of the International Workshop on Modeling in Software Engineering (MISE '07), ICSE Workshop*, (IEEE Computer Society), pp. 4.
- Biostat Inc. (2006). *Comprehensive meta-analysis v2*.
- Blaha, M.R., and Rumbaugh, J.R. (2004). *Object-oriented modeling and design with UML* (Upper Saddle River, NJ: Pearson).
- Borenstein, M., Hedges, L., and Rothstein, H. (2007). Meta-analysis fixed effect vs. random effect.

- Brereton, P., Kitchenham, B.A., Budgen, D., Turner, M., and Khalil, M. (2007). Lessons from applying the systematic literature review process within the software engineering domain. *Journal of Systems and Software* 80, 571–583.
- Briand, L.C., Bunse, C., and Daly, J.W. (2001a). A controlled experiment for evaluating quality guidelines on the maintainability of object-oriented designs. *IEEE Transactions on Software Engineering* 27, 513–530.
- Briand, L.C., Wüst, J., and Lounis, H. (2001b). Replicated case studies for investigating quality factors in object-oriented designs. *Empirical Software Engineering* 6, 11–58.
- Briand, L.C., Labiche, Y., Di Penta, M., and Yan-Bondoc, H. (2005). An experimental investigation of formality in UML-based development. *IEEE Transactions on Software Engineering* 31, 833–849.
- Bruegge, B., and Dutoit, A.H. (2010). *Object-oriented software engineering: using UML, patterns, and Java* (Boston: Prentice Hall).
- Budgen, D., Burn, A.J., Brereton, O.P., Kitchenham, B.A., and Pretorius, R. (2011a). Empirical evidence about the UML: A systematic literature review. *Journal of Software: Practice and Experience* 41, 363–392.
- Budgen, D., Burn, A.J., and Kitchenham, B. (2011b). Reporting computing projects through structured abstracts: a quasi-experiment. *Empirical Software Engineering* 16, 244–277.
- Burge, J.E., Carroll, J.M., McCall, R., and Mistrík, I. (2008). *Rationale-based software engineering* (Springer-Verlag Berlin Heidelberg).
- Cant, S., Jeffery, D., and Henderson-Sellers, B. (1995). A conceptual model of cognitive complexity of elements of the programming process. *Information and Software Technology* 37, 351–362.
- Carver, J. (2010). Towards reporting guidelines for experimental replications: A proposal. In *Proceedings of the 1st International Workshop on Replication in Empirical Software Engineering Research (RESER'10)*, Held during ICSE'10, p.
- CASP UK (2008). *CASP critical appraisal skills programme* Oxford UK.
- Chaudron, M., and Jolak, R. (2015). A vision on a new generation of software design environments. In *Proceedings of the First International Workshop on Human Factors in Modeling (HuFaMo 2015)*. Chalmers Publication Library (CPL), pp. 11–16.
- Cherubini, M., Venolia, G., DeLine, R., and Ko, A.J. (2007). Let's go to the whiteboard: How and why software developers use drawings. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (SIGCHI'07)*, (New York, NY, USA: ACM), pp. 557–566.
- Cochrane Collaboration (2003). *Cochrane reviewers' handbook*.
- Cohen, D., Lindvall, M., and Costa, P. (2004). An introduction to agile methods. *Advances in Computers* 62, 2–67.
- Conover, W.J. (1998). *Practical nonparametric statistics* (Wiley).
- Cook, T.D., Shadish, W.R., Jr, and Campbell, D.T. (2001). *Experimental and quasi-experimental designs for generalized causal inference* (Boston: Cengage Learning, Inc).
- Creswell, J.W. (2013). *Research design: qualitative, quantitative, and mixed methods approaches* (Thousand Oaks: SAGE Publications, Inc).
- Cruzes, D.S., Dyba, T., Runeson, P., and Host, M. (2011). Case studies synthesis: brief experience and challenges for the future. In *Proceedings of the 2011 International*

- Symposium on Empirical Software Engineering and Measurement (ESEM'11), pp. 343–346.
- Cruz-Lemus, J.A., Genero, M., Caivano, D., Abrahão, S., Insfrán, E., and Carsí, J.A. (2010). Assessing the influence of stereotypes on the comprehension of UML sequence diagrams: A family of experiments. *Information and Software Technology* 53, 1391–1403.
- Dekel, U., and Herbsleb, J.D. (2007). Notation and representation in collaborative object-oriented design: An observational study. In *Proceedings of the 22Nd Annual ACM SIGPLAN Conference on Object-Oriented Programming Systems and Applications (OOPSLA'07)*, (New York, NY, USA: ACM), pp. 261–280.
- Deligiannis, I.S., Shepperd, M., Webster, S., and Roumeliotis, M. (2002). A review of experimental investigations into object-oriented technology. *Empirical Software Engineering* 7, 193–231.
- Devore, J.L., and Farnum, N. (1999). *Applied statistics for engineers and scientists* (Duxbury Press).
- Diamond, S.S. (2011). Reference manual on scientific evidence. In *Reference Manual on Scientific Evidence*, (Federal Judicial Center/National Academy of Sciences), pp. 359–423.
- Dobing, B., and Parsons, J. (2006). How UML is used? *Communications of the ACM* 49, 109–113.
- Dybå, T., and Dingsøy, T. (2008a). Empirical studies of agile software development: A systematic review. *Information and Software Technology* 50, 833–859.
- Dybå, T., and Dingsøy, T. (2008b). Strength of evidence in systematic reviews in software engineering. In *Proceedings of the Second ACM-IEEE International Symposium on Empirical Software Engineering and Measurement (ESEM'08)*, (New York, NY, USA: ACM), pp. 178–187.
- Dzidek, W.J. (2008). Empirical evaluation of the costs and benefits of UML in software maintenance. University of Oslo.
- Dzidek, W.J., Arisholm, E., and Briand, L.C. (2008). A realistic empirical evaluation of the costs and benefits of UML in software maintenance. *IEEE Transactions on Software Engineering* 34, 407–432.
- Erickson, J., and Siau, K. (2007). Theoretical and practical complexity of modeling methods. *Communications of the ACM* 50, 46–51.
- Ericksson, H.E., Penker, M., Lyons, B., and Fado, D. (2004). *UML 2 toolkit* (Wiley).
- Fernández-Sáez, A., Genero, M., and Romero, F. (2010). SLR-Tool - A tool for performing systematic literature reviews. In *Proceedings of the Fifth International Conference on Software and Data Technologies (ICSOFT'10)*, (Athens, Greece), pp. 157–166.
- Fernández-Sáez, A.M., Genero, M., and Chaudron, M.R.V. (2012). Does the level of detail of UML models affect the maintainability of source code? In *Proceedings of the Experiences and Empirical Studies in Software Modelling Workshop (EESSMod'12)*, at the International Conference on Models in Software Engineering (MODELS'12), (Wellington, New Zealand: LNCS 7167), pp. 133–147.
- Fernández-Sáez, A.M., Genero, M., and Chaudron, M.R.V. (2013a). Empirical studies concerning the maintenance of UML diagrams and their use in the maintenance of code: A systematic mapping study. *Information and Software Technology* 55, 1119–1142.

- Fernández-Sáez, A.M., Chaudron, M.R.V., Genero, M., and Ramos, I. (2013b). Are forward designed or reverse-engineered UML diagrams more helpful for code maintenance?: a controlled experiment. In *Proceedings of the 17th International Conference on Evaluation and Assessment in Software Engineering (EASE'13)*, (New York, NY, USA: ACM), pp. 60–71.
- Fernández-Sáez, A.M., Chaudron, M.R.V., and Genero, M. (2013c). Exploring costs and benefits of using UML on maintenance: preliminary findings of a case study in a large IT department. In *Proceedings of the 2013th International Conference on Models in Software Engineering (MODELS'13), Experiences and Empirical Studies in Software Modelling Workshop (EESSMoD'13)*, pp. 33–42.
- Fernández-Sáez, A.M., Genero, M., Caivano, D., and Chaudron, M.R.V. (2014). Does the level of detail of UML diagrams affect the maintainability of source code?: a family of experiments. *Empirical Software Engineering* 12, 1–48.
- Fernández-Sáez, A.M., Genero, M., Chaudron, M.R.V., Caivano, D., and Ramos, I. (2015a). Are forward designed or reverse-engineered UML diagrams more helpful for code maintenance?: A family of experiments. *Information and Software Technology* 57, 644–663.
- Fernández-Sáez, A.M., Caivano, D., Genero, M., and Chaudron, M.R.V. (2015b). On the use of UML documentation in software maintenance: Results from a survey in industry. In *Proceedings of the 18th ACM/IEEE International Conference on Model Driven Engineering Languages and Systems (MODELS'15)*, (Ottawa, ON, Canada), pp. 292–301.
- Fink, A.G. (2002). *The survey handbook* (Thousand Oaks, Calif: SAGE Publications, Inc).
- Fjeldstad, R.K., and Hamlen, W.T. (1979). Application program maintenance study: report to our respondents. In *Proceedings of GUIDE 48*, (Philadelphia, PA), p.
- Forward, A., and Lethbridge, T.C. (2002). The relevance of software documentation, tools and technologies: A survey. In *Proceedings of the 2002 ACM Symposium on Document Engineering (DocEng'02)*, (New York, NY, USA: ACM), pp. 26–33.
- Forward, A., Lethbridge, T.C., and Badreddin, O. (2010). Perceptions of software modeling: a survey of software practitioners. In *Proceedings of the 5th Workshop from Code Centric to Model Centric: Evaluating the Effectiveness of MDD (C2M: EEMDD'10)*, (Paris, France).
- France, R., Bieman, J., and Cheng, B.H.C. (2006). Repository for model driven development (ReMoDD). In *Proceedings of the International Conference on Model Driven Engineering Languages and Systems (MODELS'06)*, (Springer, Berlin, Heidelberg), pp. 311–317.
- Garousi, G., Garousi, V., Moussavi, M., Ruhe, G., and Smith, B. (2013). Evaluating usage and quality of technical software documentation: An empirical study. In *Proceedings of the 17th International Conference on Evaluation and Assessment in Software Engineering (EASE'13)*, (ACM), pp. 24–35.
- Garousi, G., Garousi-Yusifoglu, V., Ruhe, G., Zhi, J., Moussavi, M., and Smith, B. (2015). Usage and usefulness of technical software documentation: An industrial case study. *Information and Software Technology* 57, 664–682.
- Genero, M., Olivas, J., Piattini, M., and Romero, F. (2001). Using metrics to predict OO information systems maintainability. In *Proceedings of the International Conference on Advanced Information Systems Engineering (CAiSE'02)*, (Springer, Berlin, Heidelberg), pp. 388–401.

- Genero, M., Manso, E., Visaggio, A., Canfora, G., and Piattini, M. (2007). Building measure-based prediction models for UML class diagram maintainability. *Empirical Software Engineering* 12, 517–549.
- Genero, M., Fernández-Sáez, A.M., Nelson, H.J., Poels, G., and Piattini, M. (2011). A systematic literature review on the quality of UML models. *Journal of Database Management* 22, 46–70.
- Glaser, B.G., and Strauss, A.L. (1967). *The discovery of grounded theory: Strategies for qualitative research* (Chicago: Transaction Publishers).
- Glass, R. (2002). *Facts and fallacies of software engineering* (Addison-Wesley).
- Glass, G.V., McGaw, B., and Smith, M. (1981). *Meta-analysis in social research* (Sage Publications).
- Glässer, U., Gotzhein, R., and Prinz, A. (2003). The formal semantics of SDL-2000: Status and perspectives. *Computer Networks* 42, 343–358.
- Gravino, C., Tortora, G., and Scanniello, G. (2010). An empirical investigation on the relation between analysis models and source code comprehension. In *Proceedings of the 2010 ACM Symposium on Applied Computing (SAC'10)*, (ACM), pp. 2365–2366.
- Grossman, M., Aronson, J.E., and McCarthy, R.V. (2005). Does UML make the grade? Insights from the software development community. *Information and Software Technology* 47, 383–397.
- Hannay, J.E., Dybå, T., Arisholm, E., and Sjøberg, D.I.K. (2009). The effectiveness of pair programming: A meta-analysis. *Information and Software Technology* 51, 1110–1122.
- Harrison, R., Counsell, S., and Nithi, R. (2000). Experimental assessment of the effect of inheritance on the maintainability of object-oriented systems. *Journal of Systems and Software* 52, 173–179.
- Hedges, L.V., and Olkin, I. (1985). *Statistical methods for meta-analysis* (Academia Press).
- Heijstek, W., and Chaudron, M.R.V. (2009). Empirical investigations of model size, complexity and effort in a large scale, Distributed Model Driven Development Process. In *Proceedings of the 35th Euromicro Conference on Software Engineering and Advanced Applications (SEAA '09)*, pp. 113–120.
- Höst, M., and Runeson, P. (2007). Checklists for software engineering case study research. In *Proceedings of the First International Symposium on Empirical Software Engineering and Measurement (ESEM '07)*, pp. 479–481.
- Höst, M., Regnell, B., and Wohlin, C. (2000). Using students as subjects - a comparative study of students and professionals in lead-time impact assessment. *Empirical Software Engineering* 5, 201–214.
- Hutchinson, J., Whittle, J., and Rouncefield, M. (2014). Model-driven engineering practices in industry: Social, organizational and managerial factors that lead to success or failure. *Science of Computer Programming* 89, 144–161.
- IEEE (1993). IEEE standard for software maintenance. IEEE Std 1219-1993 1–45.
- ISO/IEC (1999). ISO/IEC 14764-1999: Software engineering maintenance.
- ISO/IEC (2005). ISO/IEC 19501:2005 Information technology - Open distributed processing - Unified Modeling Language (UML) (International Organization for Standardization).
- ISO/IEC (2008). ISO/IEC 25000: Software engineering (International Organization for Standardization).

- ISO/IEC (2014). ISO/IEC 25001: Systems and software engineering - Systems and software Quality Requirements and Evaluation (SQuaRE) - Planning and management (International Organization for Standardization).
- Jacobson, I., Booch, G., and Rumbaugh, J. (1999). *The unified software development process* (Boston, MA, USA: Addison-Wesley Longman Publishing Co., Inc.).
- Jedlitschka, A., Ciolkowsoki, M., and Pfahl, D. (2008). Reporting experiments in software engineering. In *Guide to Advanced Empirical Software Engineering*, F. Shull, J. Singer, and D.I.K. Sjøberg, eds. (Springer Verlag), p.
- Johnson, P., Ekstedt, M., and Jacobson, I. (2012). Where's the theory for software engineering? *IEEE Software* 29, 96–96.
- Juristo, N., and Moreno, A. (2001). *Basics of software engineering experimentation* (Kluwer Academic Publishers).
- Juristo, N., Vegas, S., Solari, M., Abrahão, S., and Ramos, I. (2013). A process for managing interaction between experimenters to get useful similar replications. *Information & Software Technology* 55, 215–225.
- Kampenes, V., Dybå, T., Hannay, J.E., and Sjøberg, D.I.K. (2007). A systematic review of effect size in software engineering experiments. *Information and Software Technology* 49, 1073–1086.
- Karahasanovic, A., and Thomas, R. (2007). Difficulties experienced by students in maintaining object-oriented Systems: an empirical study. In *Proceedings of the Australasian Computing Education Conference (ACE'07)*, pp. 81–87.
- Kirk, R.E. (1995). *Experimental design. procedures for the behavioural sciences* (Brooks/Cole Publishing Company).
- Kitchenham, B., and Charters, S. (2007). *Guidelines for performing systematic literature reviews in software engineering* (Keele University).
- Kitchenham, B.A., and Pfleeger, S.L. (2002). Principles of survey research part 2: designing a survey. *ACM SIGSOFT Software Engineering Notes* 27, 18–20.
- Kitchenham, B.A., and Pfleeger, S.L. (2008). Personal opinion surveys. In *Guide to Advanced Empirical Software Engineering*, F. Shull, J. Singer, and D.I.K. Sjøberg, eds. (Springer London), pp. 63–92.
- Kitchenham, B.A., Pfleeger, S., Hoaglin, D.C., Emam, K.E., and Rosenberg, J. (2002). Preliminary guidelines for empirical research in software engineering. *IEEE Transactions on Software Engineering* 28, 721–734.
- Kitchenham, B.A., Brereton, P., Turner, M., Niazi, M.K., Linkman, S., Pretorius, R., and Budgen, D. (2010). Refining the systematic literature review process—two participant-observer case studies. *Empirical Software Engineering* 15, 618–653.
- Kitchenham, B.A., Budgen, D., and Brereton, P. (2015). *Evidence-Based Software Engineering and Systematic Reviews* (Boca Raton: Chapman and Hall/CRC).
- Kitchenham, B., Budgen, D., and Brereton, P. (2011). Using mapping studies as the basis for further research – A participant-observer case study. *Information and Software Technology* 53, 638–651.
- Kruchten, P., Capilla, R., and Dueñas, J.C. (2009). The decision view's role in software architecture practice. *IEEE Software* 26, 36–42.

- Kuzniarz, L., Staron, M., and Wohlin, C. (2013). Students as study subjects in software engineering experimentation. In *Proceedings of the 3rd Conference on Software Engineering Research and Practice*, (Lund, Sweden), pp. 19–24.
- Kvale, S. (1996). *InterViews: An introduction to qualitative research interviewing* (SAGE Publications, Inc).
- Lange, C.F.J., Chaudron, M.R.V., and Muskens, J. (2006). In practice: UML software architecture and design description. *IEEE Software* 23, 40–46.
- Lauesen, S. (2002). *Software requirements: Styles and techniques* (Addison-Wesley).
- Leotta, M., Ricca, F., Antoniol, G., Garousi, V., Zhi, J., and Ruhe, G. (2013). A Pilot experiment to quantify the effect of documentation accuracy on maintenance tasks. In *Proceedings of the 29th IEEE International Conference on Software Maintenance (ICSM'13)*, pp. 428–431.
- Liebel, G., Marko, N., Tichy, M., Leitner, A., and Hansson, J. (2016). Model-based engineering in the embedded systems domain: an industrial survey on the state-of-practice. *Software and System Modelling* 27(1), 1–23.
- Lientz, B.P., and Swanson, E.B. (1980). *Software maintenance management* (Addison - Wesley).
- Lindsay, R.M., and Ehrenberg, A.S.C. (1993). The design of replicated studies. *The American Statistician* 47, 217–228.
- Liu, J., Dehlinger, J., and Lutz, R. (2005). Safety analysis of software product lines using state-based modeling. In *Proceedings of the 16th IEEE International Symposium on Software Reliability Engineering (ISSRE'05)*, pp. 10-30.
- Locke, K. (2001). *Grounded theory in management research* (London ; Thousand Oaks, Calif: SAGE Publications Ltd).
- Lutters, W.G., and Seaman, C.B. (2007). Revealing actual documentation usage in software maintenance through war stories. *Information and Software Technology* 49, 576–587.
- McNamara, C. (1999). *General guidelines for conducting interviews* (Minneapolis, MN: Authenticity Consulting, LLC).
- Mellegård, N., and Staron, M. (2010). Characterizing model usage in embedded software engineering: A Case Study. In *Proceedings of the Fourth European Conference on Software Architecture: Companion Volume (ECSA'10)*, (New York, NY, USA: ACM), pp. 245–252.
- Mohagheghi, P., Dehlen, V., and Neple, T. (2009). Definitions and approaches to model quality in model-based software development - A Review of Literature. *Information and Software Technology* 51, 1646–1669.
- Nugroho, A. (2009). Level of detail in UML models and its impact on model comprehension: A controlled experiment. *Information and Software Technology* 51, 1670–1685.
- Nugroho, A., and Chaudron, M.R.V. (2007). A survey of the practice of design - Code correspondence amongst professional software engineers. In *Proceedings of the First International Symposium on Empirical Software Engineering and Measurement (ESEM'07)*, (Washington, DC, USA: IEEE Computer Society), pp. 467–469.
- Nugroho, A., and Chaudron, M.R.V. (2008). A survey into the rigor of UML use and its perceived impact on quality and productivity. In *Proceedings of the Second ACM-IEEE International Symposium on Empirical Software Engineering and Measurement (ESEM'08)*, (ACM), pp. 90–99.

- Nugroho, A., and Chaudron, M.R.V. (2009). Evaluating the impact of UML modeling on software quality: An industrial case study. In Proceedings of the 12th International Conference on Model Driven Engineering Languages and Systems (MODELS'09), (Springer), pp. 181-195.
- Nugroho, A., Flaton, B., and Chaudron, M.R.V. (2008). Empirical analysis of the relation between level of detail in UML models and defect density. In Proceedings of the International Conference on Model Driven Engineering Languages and Systems (MoDELS'08), pp. 600–614.
- OMG (1997). The Unified modeling language. Documents associated with UML version 1.1.
- OMG (2003). MDA guide version 1.0.
- OMG (2010). The unified modeling language. Documents associated with UML version 2.3.
- OMG (2011). The unified modeling language. Documents associated with UML version 2.4.1: <http://www.omg.org/spec/UML/2.4.1>.
- Oppenheim, A.N. (2000). Questionnaire design, interviewing and attitude measurement (Bloomsbury Academic).
- Osman, H., Stikkolorum, D., Zadelhoff, A. van, and Chaudron, M.R.V. (2012). UML class diagram simplification: What is in the developer's mind? In Proceedings of the 2012 International Conference on Models in Software Engineering (MODELS'12), Experiences and Empirical Studies in Software Modelling Workshop (EESMod'12), Article No. 5.
- Perez-Castillo, R., de Guzman, I.G.-R., Piattini, M., and Ebert, C. (2011). Reengineering technologies. *IEEE Software* 28, 13–17.
- Petersen, K., Feldt, R., Mujtaba, S., and Mattsson, M. (2008). Systematic mapping studies in software engineering. In Proceedings of the 12th International Conference on Evaluation and Assessment in Software Engineering (EASE'08), (Swinton, UK, UK: British Computer Society), pp. 68–77.
- Petre, M. (2013). UML in practice. In Proceedings of the 35th International Conference on Software Engineering (ICSE '13), (San Francisco, CA, USA (forthcoming)), pp. 722–731.
- Petre, M., and Blackwell, A.F. (1999). Mental imagery in program design and visual programming. *International Journal of Human-Computer Studies* 51, 7–30.
- Petticrew, M., and Roberts (2006). Systematic Reviews in the social sciences: A practical guide (Blackwell Publishing).
- Pfleeger, S., and Kitchenham, B. (2001). Principles of survey research: Part 1: Turning lemons into lemonade. *ACM SIGSOFT Software Engineering Notes* 26, 16–18.
- Pigoski, T.M. (2001). Chapter 6: Software maintenance. In *SWEBOK: A project of the software engineering coordination committee (Trial Version 1.00)*, (Los Alamitos, CA: IEEE Computer Society Press).
- Pinsonneault, A., and Kraemer, K.L. (1993). Survey research methodology in management information systems: an assessment. *Journal of Management Information Systems - Special Section: Strategic and Competitive Information Systems* 10, 75–105.
- Pippenger, N. (1978). Complexity Theory. *Scientific American* 238.
- Poels, G., and Dedene, G. (2000). Measures for assessing dynamic complexity aspects of object-oriented conceptual schemes. In Proceedings of the 19th International Conference on Conceptual Modeling (ER '00), (Berlin, Heidelberg: Springer-Verlag), pp. 499–512.
- Popper, K.R. (1959). The logic of scientific discovery (Cambridge: Hutchinson & Co).

- Pressman, R.S. (2005). *Software engineering: a practitioners approach* (McGraw Hill).
- Priestley, M., and Utt, M.H. (2000). A unified process for software and documentation development. In *Proceedings of 2000 Joint IEEE International and 18th Annual Conference on Computer Documentation (IPCC/SIGDOC '00)*, pp. 221–238.
- Punch, K.F. (2005). *Introduction to social research, second edition: Quantitative and qualitative approaches* (London ; Thousand Oaks, Calif: SAGE Publications Ltd).
- Ricca, F., Leotta, M., Reggio, G., Tiso, A., Guerrini, G., and Torchiano, M. (2012). Using UniMod for maintenance tasks: An experimental assessment in the context of model driven development. In *Proceedings of the 4th International Workshop on Modeling in Software Engineering (MiSE'12)*, pp. 77–83.
- Richards, L. (1999). *Using NVIVO in qualitative research* (SAGE Publications Ltd).
- Robson, C. (2002). *Real world research: A resource for social scientists and practitioner-researchers* (Wiley).
- Roehm, T., Tiarks, R., Koschke, R., and Maalej, W. (2012). How do professional developers comprehend software? In *Proceedings of the 34th International Conference on Software Engineering (ICSE'12)*, (Piscataway, NJ, USA: IEEE Press), pp. 255–265.
- Runeson, P., and Höst, M. (2009). Guidelines for conducting and reporting case study research in software engineering. *Empirical Software Engineering* 14, 131–164.
- Runeson, P., Höst, M., Rainer, A., and Regnell, B. (2012). Case study research in software engineering: Guidelines and examples.
- Scanniello, G., Gravino, C., and Tortora, G. (2010). Investigating the role of UML in the software modeling and maintenance - a preliminary industrial survey. In *Proceedings of the International Conference on Enterprise Information Systems (ICEIS'10)*, (SciTePress), pp. 141–148.
- Scanniello, G., Gravino, C., and Tortora, G. (2012). Does the combined use of class and sequence diagrams improve the source code comprehension? Results from a controlled experiment. In *Proceedings of the Experiences and Empirical Studies in Software Modelling Workshop (EESMoD'12)*, Article No. 4.
- Scanniello, G., Gravino, C., Genero, M., Cruz-Lemus, J.A., and Tortora, G. (2014). On the impact of UML analysis models on source-code comprehensibility and modifiability. *ACM Transactions of Software Engineering Methodologies* 23, 1–26.
- Seaman, C.B. (1999). Qualitative methods in empirical studies of software engineering. *IEEE Transactions on Software Engineering* 25, 557–572.
- Service, R.W. (2009). Book Review: Corbin, J., & Strauss, A. (2008). *Basics of qualitative research: techniques and procedures for developing grounded theory* (3rd ed.). Thousand Oaks, CA: Sage. *Organizational Research Methods* 12, 614–617.
- Sheskin, D. (2007). *Handbook of parametric and nonparametric statistical procedures* (Chapman and Hall).
- Shull, F., Mendonça, M.G., Basili, V.R., Carver, J., Maldonado, J.C., Fabbri, S., Travassos, G.H., and Ferreira, M.C. (2004). Knowledge-sharing issues in experimental software engineering. *Empirical Software Engineering* 9, 111–137.
- Siau, K. (1999). Information modeling and method engineering: A psychological perspective. *Journal of Database Management* 10, 44–50.

- Singer, J., and Vinson, N.G. (2002). Ethical issues in empirical studies of software engineering. *IEEE Transactions on Software Engineering* 28, 1171–1180.
- Sjøberg, D.I.K., Hannay, J.E., Hansen, O., Kampenes, V.B., Karahasanovic, A., Liborg, N., and Rekdal, A.C. (2005). A survey of controlled experiments in software engineering. *IEEE Transaction on Software Engineering* 31, 733–753.
- Sjøberg, D.I.K., Dybå, T., Anda, B.C.D., and Hannay, J.E. (2008). Building theories in software engineering. In *Guide to Advanced Empirical Software Engineering*, (Springer, London), pp. 312–336.
- Šmite, D., Wohlin, C., Gorschek, T., and Feldt, R. (2010). Empirical evidence in global software engineering: a systematic review. *Empirical Software Engineering* 15, 91–118.
- Sony (2010). Sony® digital voice editor version 3.3.01.
- de Souza, S.C.B., Anquetil, N., and de Oliveira, K.M. (2005). A study of the documentation essential to software maintenance. In *Proceedings of the 23rd Annual International Conference on Design of Communication: Documenting & Designing for Pervasive Information (SIGDOC'05)*, (Coventry, United Kingdom: ACM), pp. 68–75.
- Spivey, J.M. (1989). *The Z notation: A reference manual* (New York, NY, USA: Prentice-Hall).
- SPSS (2003). *SPSS 12.0, syntax reference guide* (Chicago, USA: SPSS Inc.).
- Steinar, K. (2007). *Doing interviews* (SAGE Publications).
- Strauss, A.C., and Corbin, J. (1990). *Basics of qualitative research: Grounded theory procedures and techniques* (SAGE Publications, Inc).
- SurveyMonkey (1999). <http://www.surveymonkey.com>.
- Swanson, E.B. (1976). The dimensions of maintenance. In *Proceedings of the 2nd International Conference on Software Engineering (ICSE'76)*, (San Francisco, California, United States: IEEE Computer Society Press), pp. 492–497.
- Thomas, D. (2004). MDA: revenge of the modelers or UML utopia? *IEEE Software* 21, 15–17.
- Tilley, S., and Huang, S. (2003). A qualitative assessment of the efficacy of UML diagrams as a form of graphical documentation in aiding program understanding. In *Proceedings of the 21st Annual International Conference on Systems Documentation (SIGDOC'03)*, pp. 184–191.
- Tomassetti, F., Torchiano, M., Tiso, A., Ricca, F., and Reggio, G. (2012). Maturity of software modelling and model driven engineering: A survey in the Italian industry. In *Proceedings of the 16th International Conference on Evaluation Assessment in Software Engineering (EASE'12)*, pp. 91–100.
- Torchiano, M., Tomassetti, F., Ricca, F., Tiso, A., and Reggio, G. (2011). Preliminary findings from a survey on the MD state of the practice. In *Proceedings of the 2011 International Symposium on Empirical Software Engineering and Measurement (ESEM'11)*, pp. 372–375.
- Torchiano, M., Tomassetti, F., Ricca, F., Tiso, A., and Reggio, G. (2013). Relevance, benefits, and problems of software modelling and model driven techniques—A survey in the Italian industry. *Journal of Systems and Software* 86, 2110–2126.
- Tryggeseth, E. (1997). Report from an experiment: Impact of documentation on maintenance. *Empirical Software Engineering* 2, 201–207.

- 
- Vegas, S., Juristo, N., Moreno, A., Solari, M., and Letelier, P. (2006). Analysis of the influence of communication between researchers on experiment replication. In *Proceedings of the ACM/IEEE International Symposium on Empirical Software Engineering (ISESE'06)*, pp. 28–37.
- Verelst, J. (2004). The influence of the level of abstraction on the evolvability of conceptual models of information systems. In *Proceedings of the International Symposium on Empirical Software Engineering (ISESE'04)*, pp. 17–26.
- van Vliet, H. (2008). *Software engineering: Principles and practice* (John Wiley & Sons).
- Whittle, J., Hutchinson, J., Rouncefield, M., Burden, H., and Heldal, R. (2013). Industrial adoption of model-driven engineering: Are the tools really the problem? In *Model-Driven Engineering Languages and Systems*, A. Moreira, B. Schätz, J. Gray, A. Vallecillo, and P. Clarke, eds. (Springer Berlin Heidelberg), pp. 1–17.
- Wieringa, R.J. (2003). Chapter 8 - Entity-relationship diagrams. In *Design Methods for Reactive Systems*, R.J. Wieringa, ed. (San Francisco: Morgan Kaufmann), pp. 77–88.
- Wieringa, R., and Daneva, M. (2015). Six strategies for generalizing software engineering theories. *Science of Computer Programming* 101, 136–152.
- Wohlin, C., Runeson, P., Höst, M., Ohlsson, M.C., Regnell, B., and Wesslén, A. (2000). *Experimentation in software engineering: an Introduction* (Norwell, MA, USA: Kluwer Academic Publishers).
- Wohlin, C., Runeson, P., Höst, M., Ohlsson, M.C., Regnell, B., and Wesslén, A. (2012). *Experimentation in software engineering: an Introduction* (Norwell, MA, USA: Springer).
- Yamashita, A., and Moonen, L. (2012). Do code smells reflect important maintainability aspects? In *Proceedings of the 28th IEEE International Conference on Software Maintenance (ICSM'12)*, pp. 306–315.
- Yin, R.K. (2002). *Case study research: Design and methods*, 3rd Edition (SAGE Publications, Inc).