
PROJECT SUMMARIES IS

UNITED STATES MARINE CORPS MANPOWER MODELING ENVIRONMENT

Hemant Bhargava, Associate Professor

Information Systems Academic Group

Sponsor: Deputy Chief of Staff (Manpower and Reserve Affairs), U.S. Marine Corps

OBJECTIVE: The U.S. Marine Corps' Manpower and Reserve Affairs Department is undergoing the development of a new generation of software to support the manpower modeling process. Building on previous analysis of the department's existing models and modeling technologies, the focus was on the redevelopment of models for routine job assignments of enlisted Marines and distribution of recruits to training schools.

SUMMARY: A decision support system was developed for recruit distribution in the U.S. Marine Corps. The system implements a basic assignment model. Its main contribution is in allowing the model manager to game the system and in methods for measuring and comparing quality of alternative solutions. The system has a complete user interface as well as connections to existing Marine Corps databases for obtaining problem inputs and for exporting solutions.

PUBLICATION:

Bhargava, H.K. and Snoap, K.J., "Re-Engineering Recruit Distribution in the U.S. Marine Corps," *Interfaces*, September 1998, submitted.

THESES DIRECTED:

Koch, G., "Re-Engineering the United States Marine Corps' Enlisted Assignment Model (EAM)," Master's Thesis, Naval Postgraduate School, June 1998.

Snoap, K., "Re-Engineering the United States Marine Corps' Recruit Distribution Model (EAM)," Master's Thesis, Naval Postgraduate School, September 1998.

OTHER:

Bhargava, H., RDdss: Decision Support System Software for Recruit Distribution, (delivered and installed at USMC Manpower and Reserve Affairs).

Bhargava, H., EAM-NPS: Optimization Model and Solver Software for Enlisted Assignment.

DoD KEY TECHNOLOGY AREA: Computing and Software

KEYWORDS: Manpower Modeling, Modeling Languages, Decision Support Systems

GENETIC STORMS: INVESTIGATING PERSIAN GULF ILLNESSES

Hemant Bhargava, Associate Professor

Information System Academic Group

Sponsor: Office of the Assistant Secretary of Defense (Health Affairs)

OBJECTIVE: The Comprehensive Clinical Evaluation Program (CCEP) database contains demographics, attributes, and results of comprehensive medical evaluations on Persian Gulf War veterans. The purpose of this research is to apply conventional and emerging data analysis techniques to the CCEP database, aiming to discover relationships and patterns that may provide answers to health problems reported by Persian Gulf War veterans.

PROJECT SUMMARIES IS

SUMMARY: In analyzing the Gulf War syndrome, a novel approach was developed — involving an encoding and solution using a genetic algorithm - to knowledge discovery in large (high-complexity) databases. As a result, there is a general purpose system for exploratory data analysis of such databases.

PUBLICATIONS:

Bhargava, H.K., “Data Mining by Decomposition: Adaptive Search for Hypothesis Generation,” *INFORMS Journal on Computing*, last revised September 1998, to appear.

Bhargava, H.K. and Carter, J., “Evolutionary Search Heuristics for Exploratory Data Analysis,” *Proceedings of the 6th INFORMS Computer Science Technical Section Conference on Computer Science and Operations Recent Advances in the Interface*, Monterey, CA, 7-9 January 1998.

DoD KEY TECHNOLOGY AREAS: Computing and Software, Other (Data Analysis)

KEYWORDS: Gulf War Syndrome, Genetic Algorithms, Exploratory Data Analysis, Heuristic Search

MANPOWER MODEL INTEGRATION AND PERSONNEL BATTLEFIELD SIMULATION

Daniel R. Dolk, Professor

Information Systems Academic Group

Sponsor: Naval Personnel Research and Development Center

OBJECTIVE: To develop an overall research plan for proceeding with the Manpower Model Integration project which will include details on building an initial prototype for the Personnel Battlefield Simulation (PBS) decision support team.

SUMMARY: The purpose of this project was to identify a decision support system (DSS) development plan for the Naval Personnel Battlefield Simulation (PBS) concept. The PBS is intended to be a multi-player simulation game environment allowing Navy decision-makers to examine the impact of different manpower policy decisions in the areas of recruiting, assignment and distribution, training, community management, and force structure. A preliminary step is to design a system which integrates various mathematical manpower models and associated data into a data warehouse-driven DSS based upon manpower readiness metrics. The work done in this stage of the project was to identify which models should be integrated, what their associated metrics are, and what data are required to implement a warehouse of these metrics.

PUBLICATION:

Dolk, D.R., “Integrated Model Management in the Data Warehouse Era,” *European Journal of Operations Research*, 1999, to appear.

CONFERENCE PRESENTATIONS:

Dolk, D.R., “Metrics Management,” CSM98: 12th JISR-IIASA Workshop on Methodologies and Tools for Complex System Modeling and Integrated Policy Assessment, Vienna, Austria, September 1998.

Dolk, D.R., “Modeling in the Data Warehouse Era,” IFIP 7.1 Working Group Conference, Vienna, Austria, September 1998.

Dolk, D.R., Murphy, M., and Thomas, G., “Metrics-Based, Spatial DSS for Manpower Readiness,” 37th Army Operations Research Society Conference (AORS 37), Fort Lee, VA, October 1998.

PROJECT SUMMARIES IS

DoD KEY TECHNOLOGY AREAS: Modeling and Simulation, Other (Readiness, Manpower)

KEYWORDS: Manpower, Metrics, Spatial Decision Support System, Simulation, Data Warehouse

ANALYSIS AND EVALUATION OF A PROTOTYPE MAINTENANCE ADVISOR EXPERT SYSTEM FOR THE MK92 FIRE CONTROL SYSTEM

**Magdi N. Kamel, Associate Professor
Information Systems Academic Group**

Sponsor: Naval Surface Warfare Center-Port Hueneme Division

OBJECTIVE: The overall objective of this ongoing project is to develop a prototype maintenance advisor expert system for MK92 Fire Control System to enhance the ability of MK92 technicians to better determine, diagnose, and resolve problems within the system.

SUMMARY: The effort for the current reporting period involved completing the following tasks: 1) Analysis of the FCS MK92 Mod 2 MAES shipboard evaluation results of deployed modules; 2) Analysis and determination of the most effective method of porting the FCS MK92 Mod 2 MAES to the FCS MK92 Mod 1 and Mod 5 systems; and 3) Determination of the most suitable methodology for the development of future modules of the FCS MK92 Maintenance Advisor Expert System.

DoD KEY TECHNOLOGY AREAS: Computing and Software, Human-System Interfaces

KEYWORDS: Expert Systems, Knowledge Acquisition, Knowledge Representation

A COMPARATIVE STUDY OF DOCUMENT WORKFLOW MANAGER APPLICATIONS

**Magdi N. Kamel, Associate Professor
Information Systems Academic Group**

**Martin J. McCaffrey, Visiting Assistant Professor
Institute for Defense Education and Analysis**

Sponsor: Naval Surface Warfare Center-Port Hueneme Division

OBJECTIVE: The objective of this project is to perform a comparative analysis of Commercial-Off-The-Shelf (COTS) Workflow products to support the integration of Port Hueneme Division, (PHD) Naval Surface Warfare Center (NSWC) workflow requirements into the Integrated Data Management System (IDMS) centralized on-line Technical Data Management System. A related objective of the project is to look into methodologies for Business Process Improvement (BPI), workflow automation, and the relationship between the two.

SUMMARY: The effort for the current reporting period included completing the following tasks: 1) Conducting a detailed study of Business Process Improvement Methodologies; 2) Investigating workflow automation approaches and related technologies; and 3) Developing and refining a methodology for using workflow technology to improve current business processes and applying the methodology to improve the technical manual changes process at Port Hueneme Division of the Naval Surface Warfare Center.

DoD KEY TECHNOLOGY AREA: Computing and Software

KEYWORDS: Document Management, Business Process Analysis, Business Process Re-Engineering, Workflow Automation, Workflow Software

PROJECT SUMMARIES IS

MEASURING AND EVALUATING MAINTENANCE PROCESS USING RELIABILITY, RISK, AND TEST METRICS

Norman F. Schneidewind, Professor
Information Systems Academic Group

Sponsor: Naval Surface Warfare Center-Dahlgren Division

OBJECTIVE: Research was conducted on the NASA Space Shuttle flight software for the purpose of investigating a hypothesis of measuring and evaluating maintenance stability.

SUMMARY: Measuring and evaluating the stability of maintenance processes is important because of the recognized relationship between process quality and product quality. The focus was on the important quality factor *reliability*. A maintenance process can quickly become unstable because the very act of installing software changes the environment; pressures operate to modify the environment, the problem, and the technological solutions. Changes generated by users and the environment and the consequent need for adapting the software to the changes is unpredictable and cannot be accommodated without iteration. Programs must be adaptable to change and the resultant change process must be planned and controlled. Large programs are never completed, they just continue to evolve. In other words, with software, one is dealing with a moving target. Maintenance is performed continuously and the stability of the maintenance process has an effect on product reliability. Therefore, when the stability was analyzed of the NASA Shuttle software maintenance process, it was important to consider the reliability of the software that the process produces. Furthermore, a consideration was the efficiency of the test effort that is a part of the process and a determinate of reliability. Therefore, these factors were integrated into a unified model, which allowed measurement of the influence of maintenance actions and test effort on the reliability of the software. The hypothesis was that these metrics would exhibit trends and other characteristics over time that would be indicative of the stability of the process. The results indicate that this is the case.

PUBLICATIONS:

Schneidewind, Norman F., "Integration of Software Reliability Predictions, Risk Analysis, and Testing Strategies," *Proceedings of the Tenth Annual Software Technology Conference*, (CD-ROM), 24 pp., Salt Lake City, UT, 20 April 1998.

Schneidewind, Norman F., "Measuring and Evaluating the Development Process Using Reliability and Test Metrics," *Proceedings of the Tenth Annual Software Technology Conference*, (CD-ROM), 50 pp., Salt Lake City, UT, 21 April 1998.

Schneidewind, Norman F., "How to Evaluate Legacy System Maintenance," *IEEE Software*, Vol. 15, No. 4, pp. 34-42, July/August 1998.

Schneidewind, Norman F., "How to Evaluate Legacy System Maintenance," *Nikkei Computer Books*, pp. 232-240, Nikkei Business Publications, Inc., 2-1-1 Hirakawacho, Chiyoda-Ku, Tokyo 102 Japan, 1998.

Schneidewind, Norman F. and Ebert, Christof, "Preserve or Redesign Legacy Systems?" *IEEE Software*, Vol. 15, No. 4, pp. 14-17, July/August 1998.

Schneidewind, Norman F., "Empirical Studies of Software Maintenance: A Report from WESS '97, Working Group 1: Defect Detection and Analysis," *Empirical Software Engineering*, Vol. 3, No. 3, pp. 300-301, Kluwer Academic Publishers, September 1998.

Schneidewind, Norman F., "Measuring and Evaluating the Development and Maintenance Process Using Reliability, Risk, and Test Metrics," *Proceedings of the International Conference on Software Maintenance*, 56 pp., Bethesda, MD, 17 November 1998.

Schneidewind, Norman F., "An Integrated Process and Product Model," *Proceedings of the International Metrics Symposium*, pp. 224-234, Bethesda, MD, 20-21 November 1998.

PROJECT SUMMARIES IS

Schneidewind, Norman F., "Measuring and Evaluating Maintenance Process Using Reliability, Risk, and Test Metrics," *IEEE Transactions on Software Engineering*, to be published.

CONFERENCE PRESENTATIONS:

Schneidewind, Norman F., "Integration of Software Process and Product Measurement and Models," Stan Ackerman Institute Symposium on Software Technology, Eindhoven University of Technology, Eindhoven, The Netherlands, 6 November 1998.

Schneidewind, Norman F., "An Integrated Model for Software Reliability and Maintainability in a Distributed System," Computer Science and Operations Research: Recent Advances in the Interface, Monterey, CA, 9 January 1998.

Schneidewind, Norman F., "Integration of Software Reliability Predictions, Risk Analysis, and Testing Strategies," Tenth Annual Software Technology Conference, Salt Lake City, UT, 20 April 1998.

Schneidewind, Norman F., "Measuring and Evaluating the Development Process Using Reliability and Test Metrics," Tenth Annual Software Technology Conference, Salt Lake City, UT, 21 April 1998.

Schneidewind, Norman F., "Measuring and Evaluating the Development and Maintenance Process Using Reliability, Risk, and Test Metrics," International Conference on Software Maintenance, Bethesda, MD, 17 November 1998.

Schneidewind, Norman F., "An Integrated Process and Product Model," International Metrics Symposium, Bethesda, MD, 20-21 November 1998.

DoD KEY TECHNOLOGY AREA: Computing and Software

KEYWORDS: Software Metrics, Software Maintenance, Modeling

CONSIDERING RELIABILITY RISK IN THE SOFTWARE MAINTENANCE PROCESS: SPACE SHUTTLE EXAMPLE

Norman F. Schneidewind, Professor

Information Systems Academic Group

Sponsor: Naval Surface Warfare Center-Dahlgren Division

OBJECTIVE: Measure and evaluate the Software Maintenance Process and Metrics-Based Software Quality Control.

SUMMARY: To gain insight about the interaction of the maintenance process with product metrics like reliability, trends were analyzed in these metrics. Two types of trends were analyzed: across releases and within a release. When analyzing trends, it was noted whether an increasing or decreasing trend was favorable. For example, an increasing trend in Time to Next Failure and a decreasing trend in Failures per KLOC would be favorable. Conversely, a decreasing trend in Time to Next Failure and an increasing trend in Failures per KLOC would be unfavorable. A favorable trend is indicative of maintenance stability if the functionality of the software has increased with time across releases and within releases. When trends in these metrics over time are favorable (e.g., increasing reliability), it could be concluded that the maintenance process is stable with respect to the software metric (reliability). Conversely, when the trends are unfavorable (e.g., decreasing reliability), it could be concluded that process is unstable. A Change Metric (CM) was developed. The CM is a quantity from 0 to 1. A positive value indicates stability; a negative value indicates instability. The numeric value of CM indicates the degree of stability or instability. CM only pertains to stability or instability with respect to the particular metric that has been evaluated (e.g., Failures/KLOC). The evaluation of stability should be made with respect to a set of metrics and not a single metric. An average of the values of CM across releases could also be computed to obtain an overall metric of stability.

PROJECT SUMMARIES IS

PUBLICATIONS:

Nikora, Allen P., Schneidewind, Norman F., and Munson, John C., "IV&V Issues in Achieving High Reliability and Safety in Critical Control Software, Final Report," "Volume 1 - Measuring and Evaluating the Software Maintenance Process and Metrics-Based Software Quality Control," "Volume 2 - Measuring Defect Insertion Rates and Risk of Exposure to Residual Defects in Evolving Software Systems," and "Volume 3 - Appendices," Jet Propulsion Laboratory, National Aeronautics and Space Administration, Pasadena, CA, 19 January 1998.

Schneidewind, Norman F., "How I Watched in Pain as IBM Outsmarted UNIVAC," *In the Beginning: Recollections of Software Pioneers*, pp. 54-61, IEEE Computer Society Press, Robert L. Glass, (ed.), 1998.

Schneidewind, Norman F., "How I Watched in Pain as IBM Outsmarted UNIVAC," *The Software Practitioner*, Robert L. Glass, (ed.), pp. 5-7, Vol. 8, No. 3-4, May-August 1998.

Schneidewind, Norman F., "How Can Changes in the Functionality of Maintained Systems be Measured?" *Proceedings of the Third Annual Workshop on Empirical Studies of Software Maintenance*, pp. 27-28, WESS '98, Bethesda, MD, 16 November 1998.

Schneidewind, Norman F., "Methods for Assessing COTS Reliability, Maintainability, and Availability," *Proceedings of the International Conference on Software Maintenance*, pp. 224-225, Bethesda, MD, 16-20 November 1998.

CONFERENCE PRESENTATIONS:

Schneidewind, Norman F., "Considering Risk in Software Reliability Predictions: A Space Shuttle Example," NASA - West Virginia University Workshop on Risk Management, Farmington, PA, 26 October 1998.

Schneidewind, Norman F., "State of the Art Presentation 2: Software Reliability Modeling for Client Server Systems," Fourth IEEE International Conference on Engineering of Complex Computer Systems, Monterey, CA, 13 August 1998.

Schneidewind, Norman F., "Have We Forgotten a Few Things in the Euphoria Over COTS?" International Workshops on Critical-Functions Considerations for ISO/IEC 15288 - System Life Cycle Processes: Panel on Off-the-Shelf Items, Monterey, CA, 11 August 1998.

Schneidewind, Norman F., "Everything You Wanted to Know About SRE But Didn't Know Who to Ask," International Symposium on Software Reliability Engineering, Paderborn, Germany, 6 November 1998.

Schneidewind, Norman F., "How Can Changes in the Functionality of Maintained Systems be Measured?" Third Annual Workshop on Empirical Studies of Software Maintenance, WESS '98, Bethesda, MD, 16 November 1998.

Schneidewind, Norman F., "Methods for Assessing COTS Reliability, Maintainability, and Availability," International Conference on Software Maintenance, Bethesda, MD, 16-20 November 1998.

DoD KEY TECHNOLOGY AREA: Computing and Software

KEYWORDS: Software Metrics, Software Reliability, Software Risk

PROJECT SUMMARIES IS

DEVELOPMENT OF NEW SOFTWARE DEPENDABILITY STANDARDS

**Norman F. Schneidewind, Professor
Information Systems Academic Group**

Sponsor: IEEE Software Engineering Standards Subcommittee

OBJECTIVE: To recommend appropriate reliability, maintainability, and availability technologies to include in new and revised software engineering standards.

SUMMARY: In general, existing software reliability standards do not address the characteristics of distributed systems, including client-server systems. This is an amazing situation given the importance of distributed systems in contemporary society. The reason for this situation is the rapid technological development of distributed systems and networks, most notably the explosive growth of the Internet. This rapid growth has made it difficult for the software reliability and standards development communities to respond to the challenge of the new technology. However, to address this deficiency, the software engineering community of the Institute of Electrical and Electronic Engineers will develop a new standard, which will include software reliability, maintainability, and availability for distributed systems.

PUBLICATIONS:

Schneidewind, Norman F., et al., "Roundtable: Weighing in on Standards," *IEEE Software*, Vol. 15, No. 6, pp. 92-102, November/December 1998.

Schneidewind, Norman F., "Issues in the Next Generation of Dependability Standards," *Proceedings of the International Symposium on Software Reliability Engineering*, pp. 101-102, Paderborn, Germany, 4-7 November 1998.

Schneidewind, Norman F., "IEEE Standard for a Software Quality Metrics Methodology: Revision," Celia Modell, (ed.), IEEE Standards Office, December 1998.

CONFERENCE PRESENTATION:

Schneidewind, Norman F., "Issues in the Next Generation of Dependability Standards," International Symposium on Software Reliability Engineering, Paderborn, Germany, 4-7 November 1998.

THESIS DIRECTED:

Flatau, Richard P., Jr., "Operationalization of Information Technology for the 21st Century (IT-21): The Flight Scheduling Function in Patrol Squadron 40 as a Case Study," Master's Thesis, Naval Postgraduate School, September 1998.

DoD KEY TECHNOLOGY AREA: Computing and Software

KEYWORDS: Software Standards, Software Dependability, Software Metrics

DECISION SUPPORT FOR VIRTUAL TEAMS: DESIGN PRINCIPLES

**Kishore Sengupta, Associate Professor
Information Systems Academic Group**

Sponsor: Naval Postgraduate School

OBJECTIVE: The objectives of this project were to: (1) propose mechanisms for supporting virtual teams with respect to the problems of conflict and the retention/use of process knowledge; (2) illustrate the requirements for creating such mechanisms through a prototype system; and (3) discuss the implications of these requirements for implementation as well as research in conflict management, process knowledge, and computer-supported collaborative work.

PROJECT SUMMARIES IS

SUMMARY: Virtual teams were used extensively in contemporary organizational settings to perform a variety of tasks. While virtual teams offered several advantages to organizations, their use in tasks such as product design created difficulties in managing conflicts and in the retention and uses of “process knowledge.”

PUBLICATIONS:

Sengupta, K. and Zhao, L., “Improving the Communicational Effectiveness of Virtual Organizations Through Workflow Automation,” *International Journal of Electronic Commerce*, Vol. 3, pp. 49-69, 1998.

Sengupta, K. and Zhao, L., “An Empirically Grounded Approach,” *Proceedings of the Thirty-First Annual Conference of the Hawaii International Conference on System Sciences*, Vol. IV, J. Nunamaker, (ed.), IEEE Computer Society Press, 1998.

Sengupta, K. and Ramesh, B., “Decision Support for Virtual Teams: Issues and Design Principles,” *Accounting, Management, and Information Technology*, 1998.

CONFERENCE PRESENTATION:

Sengupta, K., “The Representation and Use of Process Knowledge in the Design of Information Systems,” AIS '98, Baltimore, MD, August 1998.

DoD KEY TECHNOLOGY AREA: Other (Virtual Teams, Decision Support Systems, Software)

KEYWORDS: Virtual Teams, Decision Support Systems, Software