

A Systematic Review of Productivity Factors in Software Development

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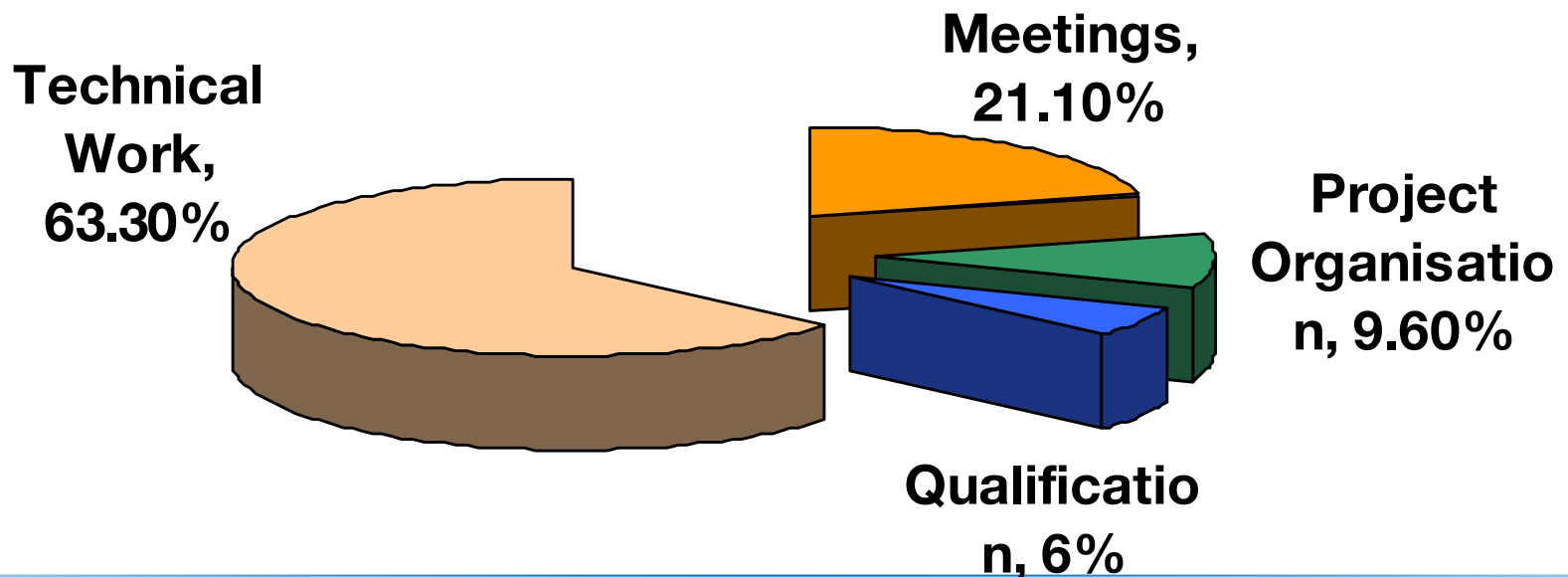
Siemens AG, Germany

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Motivation

The scientific discussion about the work situation in software development and about productivity factors is done based on an insufficient empirical basis.

Frese and Brodbeck, 1994



Problem Statement

- The basis of productivity research is thin
- Needs more empirically founded results
- Comprehensive models
- What factors influence software development productivity?

Review Approach

- Combined automatic and manual search
- Automatic search
 - ACM's The Guide: 10.017
 - IEEE Xplore: 1,408
 - ScienceDirect: 508
 - Google Scholar: 680,000
 - Inspected 100 hits each manually
- Further journals
 - Software Engineering
 - Management
 - Organisational Psychology
- Boehm et al., 2000 and Jones, 2000 as baseline
- Further manual searches
- Unification of terms
- Vote counting of publications that found that a factor has an effect on productivity

1970-1979

- Seminal study by Walston and Felix in 1977
 - Many later studies use the same or similar factors
 - Several factors decreased in importance, e.g. *chief programmer team usage*
 - Majority is still valid
 - Overall constraints on program design
 - User participation
 - Previous experience with programming language
- Albrecht proposed his famous function points in 1979

1980-1989

- Jones starts his research in programming productivity in 1986
 - First studies over a large number of projects and companies
 - Quantitative data
- DeMarco and Lister publish Peopleware in 1987
 - Strong emphasis on soft factors
 - Mainly anecdotal
- Boehm describes COCOMO in 1988
 - A set of cost-drivers that influence productivity
 - Factors used by many other studies

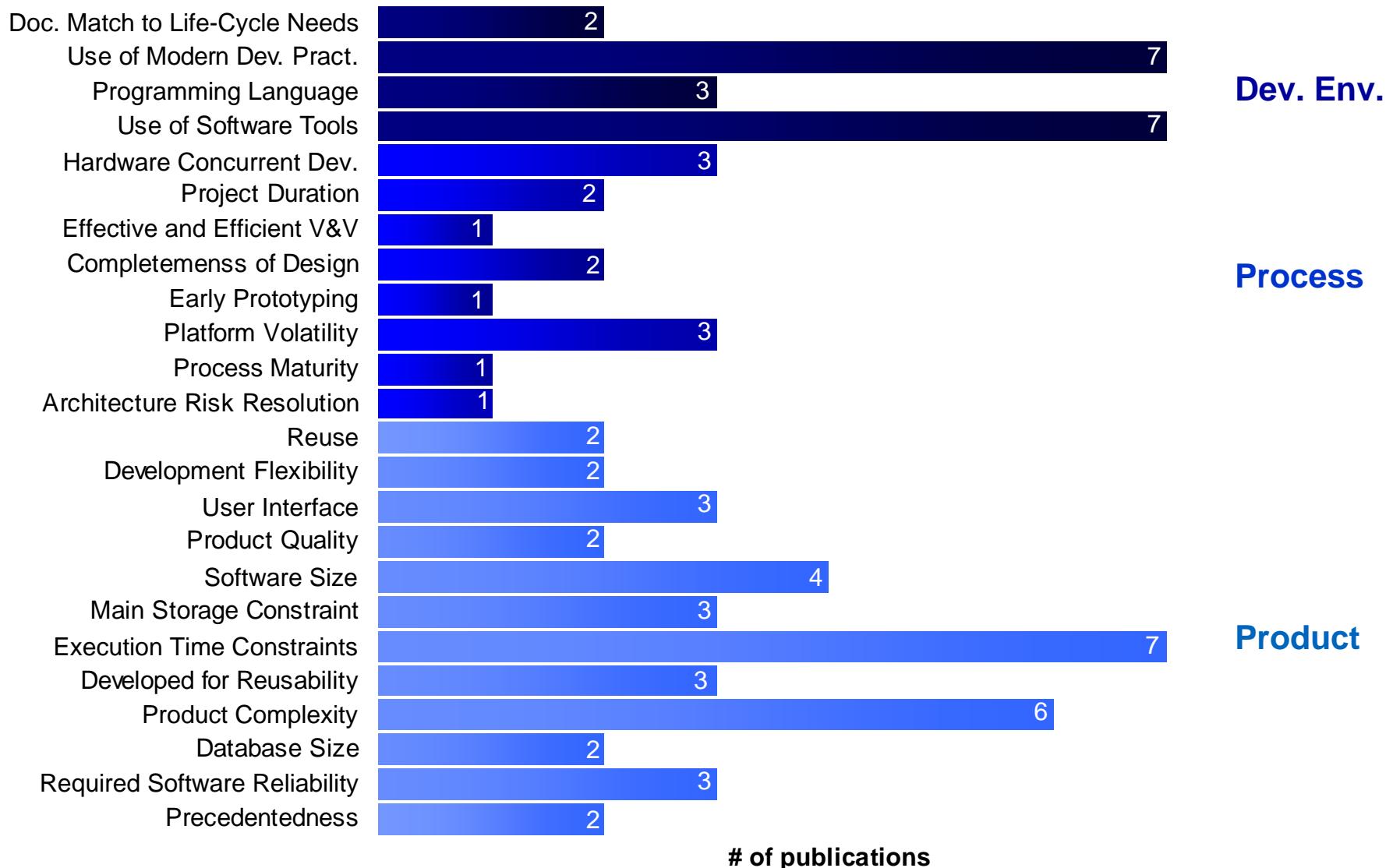
1990-1999

- Stronger interest in soft factors
 - Team member rotation
 - Role ambiguity
 - Group characteristics
- Studies on project failures or “runaways” by Glass
 - Huge projects
 - Multiplicity of failure causes
 - Breakthrough systems
- Studies on virtual offices
 - “teamwork has been diminished”
- Studies on object-orientation

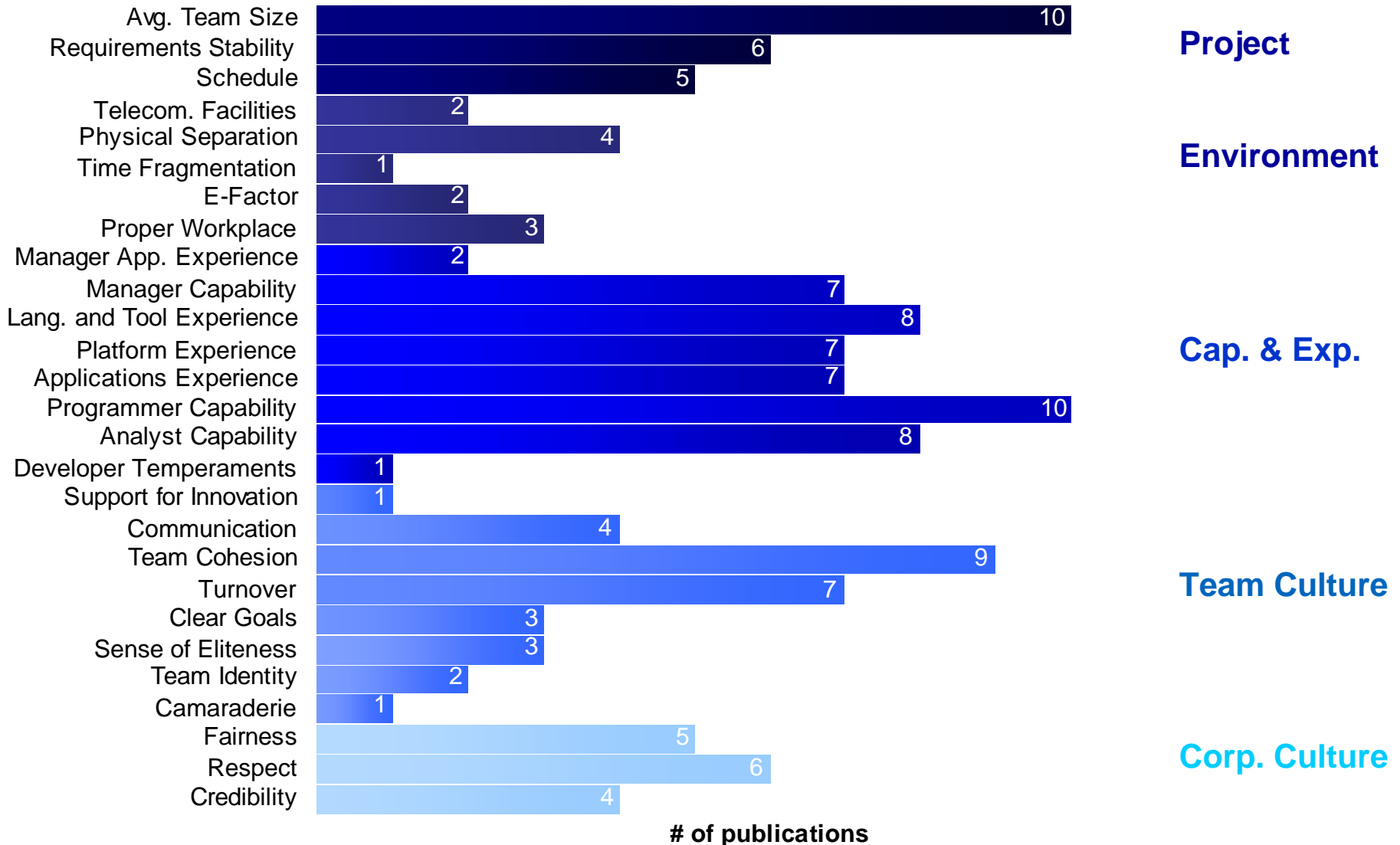
2000-2007

- COCOMO II by Boehm et al.
- Jones (2000) gives 250 productivity factors
 - Individual projects “are usually affected by ten to 20 major issues”.
 - Support for video conferencing
- Maxwell and Forselius: influencing factors depend on domain
- Kitchenham and Mendes: reuse has significant effect

Technical Factors



Soft Factors



Conclusions

- Productivity research has now unique model
- Systematic Review
 - Involves 70 of more than 100 analysed scientific publications
 - Software Engineering, Management, Organisational Psychology, Architecture, ...
- Development of seemingly relevant factors over time
- Summary of often used factors
- Only a starting point...