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Organizations may find investing in EUD more costly, but such IT appropriations may prove economically sound since it will ultimately allow end users to tailor software to their needs.

THE ECONOMICS OF END-USER DEVELOPMENT

THE PRODUCTIVITY PARADOX RAISED CONCERNS THAT IT investment rarely leads to productivity gains [1]. End-user development (EUD), however, may provide the answer to this concern if increased productivity can be demonstrated. Recent research has questioned the productivity paradox and substantially improved our understanding about how IT productivity may be influenced by the manner of change.

Brynjolfsson and Hitt [1] argue that most of the IT productivity effects do not directly result from computer applications, but should be attributed to the process of appropriation in their organizational settings. Investments in the appropriation processes are a magnitude higher than those for the initial introduction of the hardware and software. Some studies suggest a ratio of up to 1:10 [2]. Empirical evidence also indicates that decentralized organizations,

characterized by self-directed work teams, higher levels of individual decision authority, and better training, introduce IT more quickly and efficiently [1]. Following these observations, we believe EUD can decentralize the software adaptation and maintenance process. The empowerment of end users to tailor their applications will render appropriation processes more effective and thus lead to more economical IT investments.

Since the impact of IT pro-

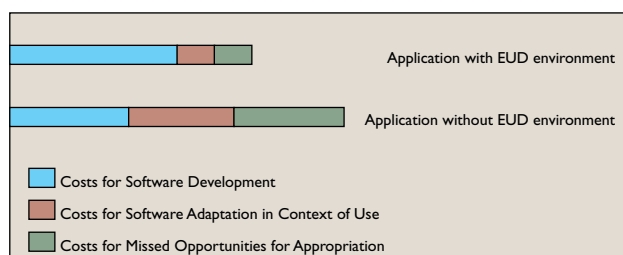
ductivity varies greatly across different firms [1], it is important to investigate organizational IT appropriations over longer periods of time. Orlikowski and Hofman [3] classify organizational transformations following the introduction of groupware along two dimensions: Whether the change is anticipated at the moment of the groupware introduction, and whether the transformation is planned and implemented purposefully.

“Anticipated changes” are organizational transformations, planned and implemented purposefully at the moment the groupware is introduced into the organization. In contrast, “opportunity-based” changes are not anticipated when introducing groupware. However, when their potential is discovered, these changes are implemented in a purposeful manner. “Emergent changes” are also not antici-

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pated, instead they are realized through decentralized unplanned activities.

To exploit the potential of opportunity-based and emergent changes, the software's functionality must typically be adapted iteratively in its context of use. In non-EUD environments, all adaptations must be realized by the software vendor, external consultants, or in-house development team. These actors are not



Cost structure for software development, adaptation, and appropriation.

involved in the business processes and do not share the respective work practices.

Consequently, considerable communication effort between users and developers is required. Adaptations are typically expensive since the existing software architecture must be understood and source code must be generated and tested. Opportunities for appropriation may be overlooked or exploited in a suboptimal manner due to communication gaps between those who can envision the business potential of change and those who understand the technology for realizing change.

EUD leads to more efficient appropriation processes by empowering users to adapt software to their local needs. It motivates users to explore the initial and potential system functionality that typically becomes a catalyst to develop innovative work practices. Obviously, there are costs involved with EUD—learning and experimenting with an EUD environment, adapting the software, testing adaptations, correcting error-prone adaptations, supporting and coordinating individual activities, and recreating adaptations after a software upgrade. However, appropriately designed EUD environments and an organizational culture of mutual support can substantially reduce these costs.

Since EUD-empowered changes are restricted to the scope of adaptation anticipated by the original designer, EUD can not fully replace the development of new software versions. Furthermore, developing software that can be adapted in its context of use is expensive. It demands more effort for generalizing requirements analysis, design of evolvable architecture, and flexible interface design. However, the additional effort can result in better software quality and payoff in the creation of enhanced software solutions.

The accompanying figure illustrates the cost structure for software development, adaptation, and organizational appropriation. The initial cost of software development is typically more expensive when realizing an EUD environment; however, EUD subsequently lowers the costs of adaptation and encourages the exploitation of opportunities for organizational appropriation. Given the ratio between costs in software and its organizational appropriation, EUD has a considerable potential to enhance the productivity of IT investments. **C**

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