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Sociotechnical Systems Design | Achieving Joint Optimization

Work is done, or at least overseen, by people. This may seem like a blindingly obvious statement, but failure to recognize the consequences of this simple fact is *the primary factor* distinguishing successful projects from unsuccessful ones. Whenever a work system is designed or modified, both technical and social components are affected. When a project falls short of its objectives, the root cause is invariably a failure to address satisfactorily one or the other of these components. The recognition that social and technical systems have to be jointly, concurrently optimized lies at the heart of the most powerful of all approaches to the design of work systems—Sociotechnical Systems Design, or STS.

In a recent special report on management, *Business Week* referred to STS as "an immensely important trend, one that is producing a new model of job design and work relations that will shape the workplace well into the 21st century." In 2008 the National Science Foundation, recognizing that cyberinfrastructure strategies built on the basis of hardware and software alone could not ensure the effectiveness of virtual work, established the VOSS Grants Program to explore Virtual Organizations as Sociotechnical Systems, which is now in its second year of funding. In short, STS is often hailed, these days, as "the next big thing" because it achieves unprecedented results in the entire range of work environments from traditional manufacturing to white-collar information work to today's virtual work systems.

Those coming to STS for the first time often experience it as a kind of revelation and are surprised to learn that STS has a long and highly successful project history. The approach was first articulated by Eric Trist and Fred Emery over fifty years ago in research on shortwall mining techniques in the UK. Since that time, STS has been applied with enormous success by a few forward-thinking managers in every major industry sector, and in the nonprofit, government, and military sectors as well. Ironically, the basic principles of what became STS were well understood by such pioneers of scientific management as Frederick Taylor and Edward Deming, though their followers often failed (sometimes catastrophically, as was the case with much of the Business Process Reengineering of the 1990s) to grasp and implement these key but less widely understood aspects of the pioneers' thought.

Projects go wrong when people fail to recognize what the great thinkers in the history of scientific management understood implicitly—that technical and social systems must be addressed concurrently. The central goal of STS, like that of other improvement methodologies, is, of course, to reduce error and eliminate variances, and experts in process control have long understood that errors and variances typically result not from worker inadequacies but from problems in work system design. The difference between STS and other approaches to work systems design lies in the degree of attention STS pays to understanding the whole system before taking action. STS practitioners use the standard process quality control tools and techniques to understand and optimize the technical system being implemented, but they also attend with equal care to the "as is" and goal states of the social system. Social system factors studied include those traditionally attended to—staffing, training, and compensation—as well as those typically neglected—issues of status, personal control and autonomy, work structure, decision-making processes, coordination mechanisms, physical space, work environment, communication flow, and job and organization design.

The Principles of Sociotechnical Systems Design

Over the 50+ years in which STS has been used, it has been refined to such a point that its core principles can be simply and clearly stated. These principles have proven their merit in the design of work systems that control variance in the most efficient and effective manner. It is perhaps easiest to understand these principles if one contrasts them with the traditional workplace design principles that they supplant.

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Traditional Design Principles	STS Design Principles
1. Error (variance) is controlled through supervisory roles or specialized functions set up specifically for control.	1. Error should be controlled at its source by whoever is closest (usually workers).
2. Information and tools necessary to control error may be withheld from those closest to the core work of a work system. Worker needs are determined by management.	2. Information and tools necessary to control error must be available to those closest to the work. Worker needs are best determined by workers.
3. Job specialization is valued. A worker who does fewer tasks will learn them quickly and be more productive.	3. Over-specialization creates coordination problems and boredom and denies workers the opportunity to learn new skills. Combine tasks to create whole jobs and variety.
4. Planning, coordination, control, and problem-solving should be done by management, or by technical experts.	4. Planning, coordination, control, and problem-solving can be accomplished in many ways—particularly by workers themselves. Worker teams can be self-regulating, given sufficient structure, support, and autonomy.
5. Organizational structure is designed around needs as perceived by managers.	5. The only legitimate rationale for any particular type of organization is how well it controls variance. Workers are usually a better source of information on how best to organize.
6. Technology is seen as value-free and is designed with efficiency as the primary objective. People should expect to adapt to technology.	6. Technology is not value-free but reflects the values of the designer. It is more readily accepted when designed with the needs of users in mind. Effectiveness is the primary objective.
7. Having the right social system is less important than having the right technology.	7. Choosing the right social system is as important as choosing the right technology.
8. Specify as much as you can. Errors may occur if you don't have detailed specification. If possible, specify what *and* how something should be done.	8. Keep specifications to a minimum and addressed only to that which is critical. Specify what, not how.