Software project stress versus quality and productivity

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ABSTRACT

Managing software project stress is the key to improving software quality and productivity. Software development is a complex intellectual process involving precise communication of abstract concepts across multiple discipline boundaries. Optimum stress maximizes communication effectiveness and the ability to deal with complexity.
INTRODUCTION

Software development is a complex intellectual process involving precise communication of abstract concepts across multiple discipline boundaries. Stress produces symptoms\(^1,2,3,4,5\) which interfere with this process.

Stress symptoms fall into several categories. Two of these categories, cognitive and behavioral, reduce quality and productivity potential by reducing the ability to handle complexity and by reducing communication effectiveness.

Cognitive stress symptoms include decreased concentration, decreased creativity, indecisiveness, intolerance for ambiguity, mental confusion, memory problems, poor judgement, and tunnel vision. These symptoms reduce the ability of the stressed person to formulate and communicate abstract concepts, thus impairing intellectual function.

Behavioral stress symptoms reduce the ability of the stressed person to communicate because these symptoms interfere with the processes of listening, speaking, reading, and writing. These symptoms include anger, anxiety, increased anti-social acts, increased grievances, overreacting to external stimuli, reduced interpersonal skill, reduced teamwork ability, and strained interpersonal relationships.

This paper describes the effect of stress on software project complexity and communication and it shows the relationship between stress and performance. It also identifies job sources of stress on software projects and proposes suggestions for managing this stress.

STRESS AND COMPLEXITY

High levels of complexity abound on software projects. Software engineering has focused on the development of structuring techniques to master this complexity.\(^6\) These techniques apply to various phases of development and classes of problems; they produce layers of system architecture in multiple levels of detail; they represent oblique levels of abstraction and frames of reference; and they reflect differing development styles, cultures, and philosophies. These techniques help to decompose complexity in an orderly fashion so that humans can handle the complexity without errors. But stress reduces the ability to use these structuring techniques effectively. Thus, software project stress counters the effect of software engineering advances.

STRESS AND COMMUNICATION

Communication is the vehicle for conveying quality and productivity objectives. It is also the vehicle for conveying and verifying the abstractions developed through structuring techniques. Certain techniques aid the communication process by requiring formal structured documents.

Communication problems\(^7,8,9,10\) are often encountered in the work environment. These problems arise when communicating abstract concepts, complex interrelationships and interdependencies, and when communicating across discipline boundaries. Problems also arise from cultural differences, defensiveness, distractions, interruptions, jargon, poor listening skills, power and status, and sociological filters. These problems interfere with the sender's encoding and sending of the intended message and with the receiver's decoding and perception of the message received.

Stress intensifies existing communication problems and adds new ones. Bolton and Bolton\(^1\) describe this reduction of adaptive behavior in interpersonal interactions as:

\[\ldots\] the predictable, unconscious shift of behavior to more extreme, rigid, and nonnegotiable forms in response to a high level of stress. Backup behavior is usually counterproductive for the person using it and very hard on his relationships. \ldots It undermines motivation; raises other people's stress thereby undercutting their productivity; and may ultimately generate more stress for the person exhibiting the backup behavior.

STRESS AND PERFORMANCE

The relationship between stress and performance is an inverted U-shaped curve\(^4,6\) with peak performance occurring at the optimum stress point.

The optimum stress point is evidenced by optimum stress indicators.\(^1,3,4,11\) When a person's stress level is at the optimum stress point these indicators are present. Optimum stress indicators include accurate judgement, composure during crisis, high energy, high morale, high motivation, improved memory and recall, interpersonal competence, mental alertness, optimistic outlook, sharp perception, thorough analysis of problems, and the ability to work long hours without tiring. Thus, people working at their optimum stress point can perform at their highest potential for quality and productivity.

As the level of stress moves away from the optimum stress point, cognitive and behavioral symptoms of stress increase. The severity of stress symptoms intensifies under prolonged exposure to stress. This cumulative stress comes from modern living\(^2\) and life changes\(^12\) as well as from the job.\(^3\)

JOB SOURCES OF SOFTWARE PROJECT STRESS

Job sources of stress\(^3,13,14\) include ambiguity, change, conflict, mismatch between person and job, responsibility, uncertainty, unhealthy interpersonal relationships, and work overload. Organizations unwittingly create stress. This reduces
the quality and productivity of the work performed by the organization.

Something that is stressful for one individual may not be stressful for others. Each individual has a unique cultural and educational background along with a unique collection of personal interests, biases, values, skills and aptitudes. Some personalities are more stress prone. Personality factors include: achievement needs, recognition needs, growth needs and social needs.

Couger and Zawacki\textsuperscript{15} found that computer professionals have high growth needs and Hackman\textsuperscript{16} found that people with high growth needs perform best in jobs that have a high motivating potential. Job design affects motivating potential as a function of the core job dimensions as follows:

\[
\text{Motivating Potential} = \frac{\text{Skill} \times \text{Task}\times \text{Variety} + \text{Identity} + \text{Significance}}{3} \times \text{Job Autonomy} \times \text{Feedback}
\]

A mismatch between growth need strength and motivating potential creates unnecessary stress.

Couger and Zawacki\textsuperscript{15} also found that computer professionals have the lowest social needs among professionals. This is consistent with job demands that require long periods of intense concentration to cope with complexity. Buie\textsuperscript{17} found that the computer profession attracts a disporportional number of introverts. Stressed by being in the company of others, the introvert prefers to work on his/her own.\textsuperscript{3} Thus, the computer professional's preference to avoid lengthy large group meetings and to have an individual private office with walls and a door is really a preference for an environment conducive to peak performance. One-on-one and small group meetings and to have an individual private office with walls and a door is really a preference for an environment conducive to peak performance.\textsuperscript{3}

Software projects are particularly sensitive to change because change taxes the low social needs of computer professionals by demanding increased social interaction. The change process increases ambiguity about current job assignments while increasing uncertainty about the future. Frequent drastic change leads to turnover. Turnover increases time pressures and work overload. The temporarily reduced work force spends precious time recruiting and training new team members as the project re-enters the teambuilding process of forming, storming, norming, and performing.\textsuperscript{18} A high rate of task reassignments and turnover increases the percent of time the project spends in the forming, storming and norming phases. These phases require more social interaction than the performing phase.

Just about any change generates more work and more stress. Change is inevitable. But, continual rapid uncontrolled change produces prolonged stress and intense stress symptoms.

MANAGING SOFTWARE PROJECT STRESS

Managing software project stress improves project performance by bringing the stress level of all project members to within an acceptable tolerance of their optimal stress point. Managing project stress is a three step process of tailoring and implementing stress reduction changes while minimizing change stress. The first step is to recognize stress through observation of symptoms. The next step is to identify the stress source(s). And the third step is to minimize the stress producing potential of stress sources through training, job design, project management, and change management. This is an ongoing iterative process.

Training reduces stress by developing needed skills. Participative workshops with structured group exercises that develop interpersonal skills while activating knowledge are superior to the traditional classroom lecture approach.

Job design reduces stress by engineering the job to fit the worker. On every project there is more than one way to distribute the work among team members. The distribution of work affects the complexity of the intra-project interfaces (both technical and interpersonal).\textsuperscript{19} Here software engineering structuring techniques can be applied to define discrete work modules with minimal interfaces and high visibility to produce jobs with high motivating potential. The job design can be further tailored by matching the skills, social needs, and growth needs of individuals to role(s) and responsibilities.

The responsibility of the project management role is to keep a project on track by producing schedules and establishing budgets, by acquiring and allocating resources, by monitoring progress, and by implementing corrective action. Whether the corrective action relieves stress or creates more stress depends on the process of assessing and implementing change.

Change management\textsuperscript{6, 20, 21} facilitates the change process of unfreezing, changing, and refreezing. People tend to resist change. The following change management techniques help to overcome this resistance:

1. Plan for change.
2. Prepare ahead of time for unexpected problems.
3. Confront difficult problems early.
4. Be flexible. Someone else's approach may be more effective.
5. Encourage participation. Change implementation will be smoother when people buy in ahead of time.
6. Stop the rumor mill by keeping people informed. Partial information is better than no information.
7. Avoid surprises.
8. Propose the change as an experiment.
9. Let others recognize the need for change.
10. Let others have control of their time by letting them develop their own change timetable.

Managing software project stress maximizes quality and productivity by managing stress sources to minimize the presence of cognitive and behavioral stress symptoms.
SUMMARY

Since complexity and communication are fundamental components of software projects, and since stress reduces both the ability to deal with complexity and the ability to communicate effectively, it follows that stress reduces the quality and productivity potential on software projects. Managing software project stress is therefore a key to improving quality and productivity.

Management techniques that allow software professionals to achieve and maintain optimum stress produce peak performers. This enhances the ability to simplify complexity into elegant solutions that are less costly to develop and easier to debug. It also enhances communication effectiveness, which promotes good rapport with clients, reduces tension, improves job satisfaction, reduces errors, and facilitates solving the right problem.

Managing stress on software projects enables people to work smarter.

REFERENCES
