

IT Software Project Management: Impact of Team Cohesiveness on Productivity and Performance

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The efficiency of IT projects and, in particular of those that are software intensive, is determined by the productivity of the project's team members. A large number and variety of researchers have proved that team cohesiveness has a major impact on productivity.

This paper analyses the determinants of team cohesiveness, the impact of project goals and specific factors, e.g. team size, challenges or exclusivity, available to project managers for use in enhancing the desirable team effects. This paper also points out however, the inevitable dangers and the potentially negative influence, which a strongly coherent team may have on project team productivity. In summary, this paper will analyze the bottom-up relationship between all of the elements, from actions encouraging team cohesiveness up to software project performance.

An awareness of this relationship led to the project management methodology of L-Timer™ presented at this conference.

1. Introduction

Software projects means millions of human decisions every second.

“Humans have only one in common: they all differ one from each other”

Robert Zend

More than ten years ago survey organisations like Standish Group Researches documented the performance of software projects on a broader scale. They confirmed the otherwise known truth, that three out of four software projects do not succeed.

Simultaneously several researches pinpointed the tremendous variation in productivity of IT-professionals – up to 1 to 10.

A conservative budget and time schedule of a project, accommodating the worst case risks emerging from the above variation, leads the manufacturers to a loss of competitiveness. An obvious alternative is to increase the productivity of an IT-professional. Contrary to the “Modern Times” experience with Charlie Chaplin, restrictions and stringiest work standards did not prove successful in software production. The virtually unlimited number of possibilities and thus decisions taken by the software architect, programmer, operator and so on, calls for a different approach towards productivity: by professionally handling the individual needs of the people involved and providing suitable methods. Our special attention is given to multinational European project teams.

This paper deduces the human factor as the decisive challenge in software projects and introduces the systematic and integral approach towards successful software project management.

2. State of the art in Software Project Performance

A project is a temporary endeavour undertaken to create a unique product or service. Temporary means that the project has an end date. Unique means that the project's final result differs from the results delivered so far by the organization. The German standard DIN 69901 [12] adds to this limited financial, human and other resources as well as a specific organization. There are over 100 definitions in most respectable publications – most include the human factor in software projects in particular. The variety of behavioural combinations of the software ventures exceeds the boldest expectations for the majority of the projects. This complexity exceeds far beyond the human capability to handle.

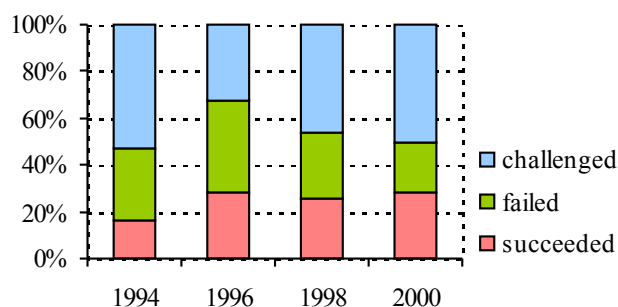


Figure 1. Project outcomes history (1994 - 2000)

The results of Standish Group Researches 1994-2000 [40], examining 30,000 projects showed that only 20 to 30 per cent of all projects succeeded on time and on budget, with all the features and functions as initially specified (Figure 1). Failed projects were cancelled before completion or never

implemented. Challenged projects were completed and operational, but over-budget, over the time estimate, and with fewer features.

The results of CHAOS research are the most widely quoted statistics in the IT industry with far reaching effects [1]. The cumulative research presents a decade of data on why projects succeed or fail – representing over 50,000 completed software projects (9,236 in 2004), plus 450 workshops, focus groups and project group therapy sessions. Fifty-eight percent (58%) of respondents are US-based, 27% are European and the remaining 15% represent the rest of the world. Forty-five percent (45%) of these companies are considered Fortune 1000 type companies; another 35% would be considered mid-range and 20% are smaller companies. They span a diverse number of vertical industries.

2004's results confirmed the earlier statistics of Standish Group Researches. It shows that 29% of all projects succeeded; 53% were challenged; and 18% failed, as shown in Figure 2 [41]:

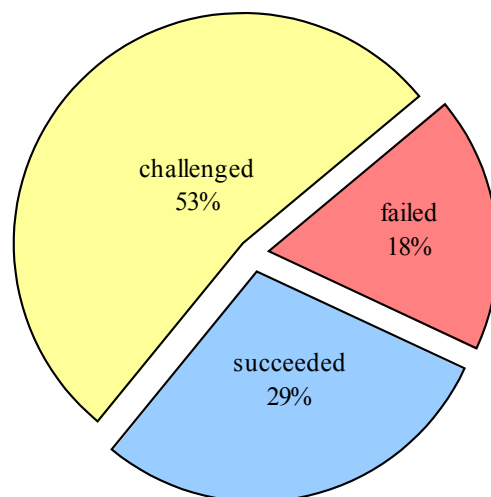


Figure 2. Projects performance 2004 according to CHAOS

The analysis of projects, which succeeded shows an almost linear decrease in percentage of the successful software projects related to the dimensions of the project: from 46% for projects below 750'000 US \$ to just 2% for over 10 million venues, demonstrating the impact of the complexity on all aspects, including certainly the human factor, as well.

3. Impact of the human factor on software project performance

The number of decisions during the realization of a software project is virtually unlimited. Thus, not surprisingly the combination chosen and the speed one moves from one decision to the next, has a

much higher impact on software project performance than in any other discipline. The studies of Software Consortium [39] lend credibility to McConnell's conclusions [24]:

- Performance differences on the order of 10-to-1 or more between different developments with the same levels of experience [6], [7], [8], [11], [27], [37].
- Boehm, in a study of 69 projects at TRW, identified that the best teams were at least 4 times as productive as the worst teams [4].
- DeMarco and Lister in a study of 166 programmers from 18 companies identified programmer productivity differences of 5.6 to 1 [10].
- In one study of 7 identical projects, the developers were all professional programmers with several years of experience who were enrolled in a computer science graduate program. The products still ranged in effort by a factor of 3.4 to 1 [5].

Lakhanpal [19] analysed 31 projects to find out the reasons for the above variations. He concluded that team cohesiveness was the number one factor, followed closely by individual performance and experience. All three are within the responsibility of the software project manager.

In this paper we analyse the number one factor – team cohesiveness.

4. Team Cohesiveness

*“Coming together is a beginning.
Keeping together is progress.
Working together is success.
Helping each other win is excellence.”
Henry Ford*

Team Cohesion is the degree to which team members hold an attraction for each other and a desire to remain intact as a team [44].

We may recognize a team with a high cohesiveness for example by:

- synchrony/symmetry/"sameness"
 - language (“we”, “our team”, “each one of us” - adopt group idioms)
 - physical (sit in circle, mirror postures/gestures)
 - “group mind”: becoming an entity
- adherence to team norms in various “strengths”:
 - permitted: OK to eat in meetings
 - preferred: should use first names (or should not)
 - prescribed: must attend all meetings

proscribed: must not dominate the discussion
must not to be late to the meeting

A wide range of other definitions reword this basic thinking: Lott [20], Moreno and Jennings [29], Festinger et al. [14], Wolfe and Box [44], Losh [21], Aamodt [1], Oxford Centre for Staff and Learning Development [34].

Martin [23] distinguishes social cohesion and task cohesion defined as follows (Figure 3):

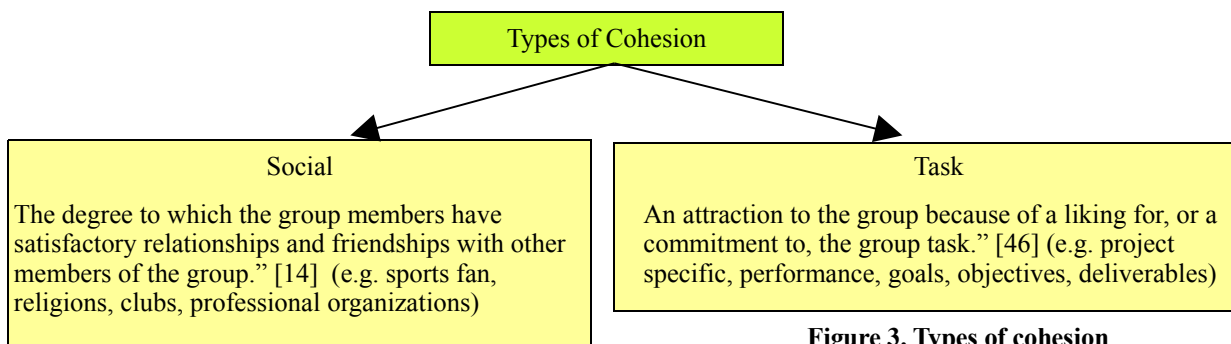


Figure 3. Types of cohesion

In particular, the task oriented work of project teams has a strong impact on team cohesiveness and thus, as is demonstrated below –on project team productivity and performance (see also [18]).

Both types of cohesiveness are important factors, influencing the attractiveness of the team. Using the term cohesiveness in the text we take both types of cohesiveness into consideration.

Team cohesiveness was subjected to thorough research in the early sixties. While two early studies (Deep et. al [9], McKenney [25]) found no relationship between team cohesion and team performance, all of the more recent studies show such a relationship to exist (Gentry 1980 [16]; Miesing 1985 [26]; Norris and Niebuhr 1980 [32]; Wolfe and Box 1988 [44]). Current studies have found that cohesiveness, perceived quality of performance and perceived equity of communication within teams has a direct influence on the degree of team satisfaction [33]. Studies have found that cohesive teams with relatively high performance goals are more productive than non-cohesive teams [47]. In fact, previous research has found that as long as team norms encourage high productivity, cohesiveness and productivity are positively related [13]. Consequently, it is believed that the cohesiveness-performance relationship is primarily due to individuals' commitment to the team members as well as to the task [30]. It is generally believed that more cohesive teams will perform better at tasks than less cohesive teams. However, there is considerable debate concerning the appropriate means by which to measure cohesiveness.

The term team cohesiveness has come to have a central place in theories of group dynamics. Although different theorists attribute somewhat different conceptual properties to the term, most agree that team cohesiveness refers to the degree to which the members of a team desire to remain in the team. Thus, the members of a highly cohesive team, in contrast to one with a low level of cohesiveness, are more concerned with their membership and are therefore more strongly motivated to contribute to the team's welfare, to advance its objectives, and to participate in its activities [15].

5. Impact of Project Goals on Team Cohesiveness and Productivity

Team cohesiveness does not automatically imply the higher productivity of a team. Various researchers [28], [35] proved that the relationships between team cohesiveness and organizational productivity are moderated by goal congruity (the alignment of the team's goals with the organization's goals). The relationship is shown in Figure 4.

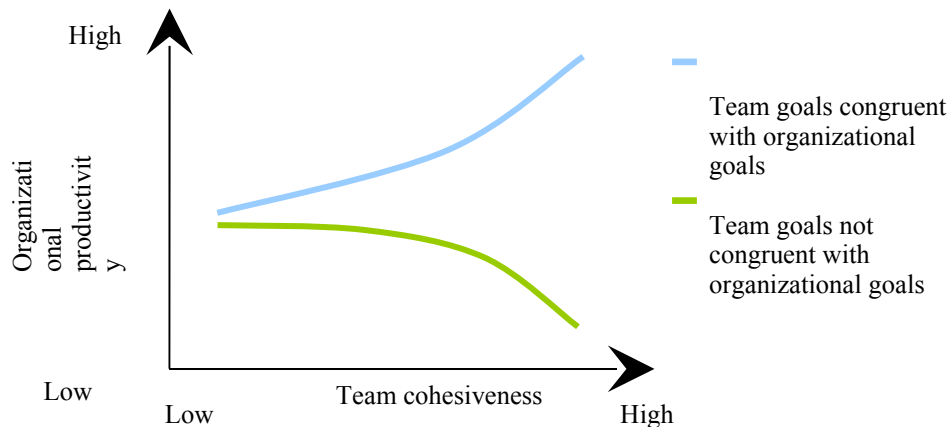


Figure 4. Organizational productivity and team cohesiveness

The positive impact of team cohesiveness, when team goals are aligned with organizational goals, is shown in Table 1. Nevertheless, the situation possesses also some potential disadvantages and it is worthwhile to observe, that high team cohesiveness does not necessarily lead to higher productivity. In the case of a non-aligned team and organizational goals we might also observe the disadvantages presented in the last column of Table 1 [36].

Consequences	Advantages	Disadvantages
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<ul style="list-style-type: none"> ▪ A high level of participation and communication within the team ▪ A high level of conformity to team norms ▪ Team goal accomplishment 	<ul style="list-style-type: none"> ▪ Team members likely to perform behaviors necessary for team and organization to achieve goals, ▪ Information flows quickly in the team, and turnover may be relatively low ▪ The team is able to control its members' behavior to achieve team goals 	<ul style="list-style-type: none"> ▪ Team members may waste time socializing on the job and chatting about non-work matters ▪ Excessive conformity within the team may result in resistance to change and failure to discard dysfunctional norms ▪ Team members may not cooperate with other groups as much as they should ▪ Team members behave in ways that are dysfunctional for the organization ▪ The team achieves its goals at the expense of organizational goals
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Table 1. Consequences of high cohesiveness

6. Factors influencing Team Cohesiveness

Robbins [36] and independently

Bloisi et al. [3] identified the major factors which influence team cohesion. Both researchers agreed that team size, member similarity and team success have an impact. Robbins sees competition and exclusiveness as two other factors, whereas Bloisi et al. distinguishes three factors - external challenges, somewhat difficult tasks and member interaction.

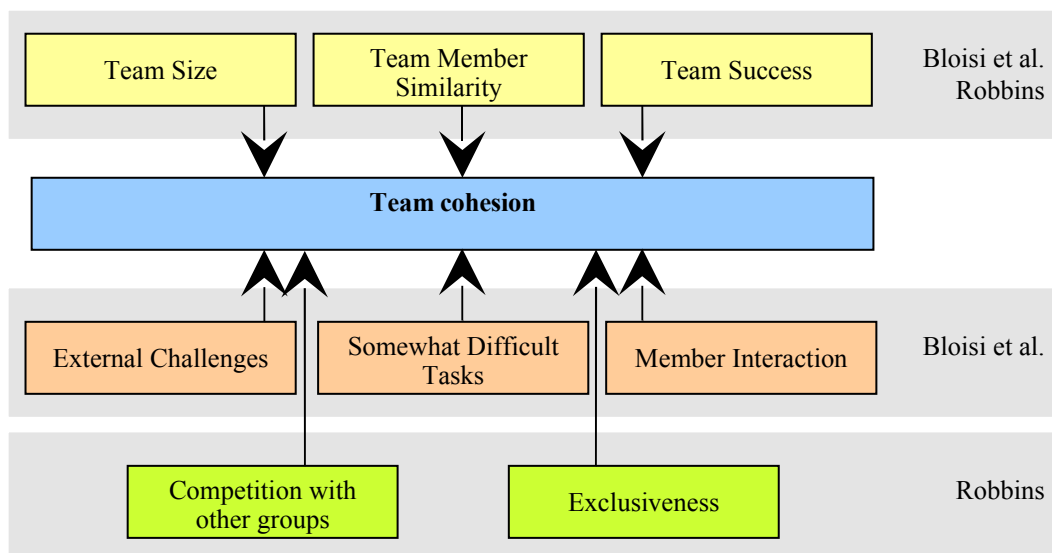


Figure 5. Determinants of group cohesion

Team Size:

The recommended team size is 3–10 members, but the best size is 5–7 members. Smaller teams (3 or 4 members) work faster and tend to produce results more quickly, but they have less diversity. Teams with more than 7 or 8 members require more expert facilitation and often require that sub-teams be formed in order for the team to operate effectively. They have the potential for more ideas and diversity. In teams of 5 – 7 members the project manager is still able to observe a number of interactions between team members and it is possible for him to control the process of team cohesion. [42].

Team Member Similarity:

Similarity refers to how closely attitudes, values, interests and personality match between team members. Similarities in opinions, interpersonal styles, amount of communication skill, demographics, and values have all been shown in experiments to increase affinity between team members. Team members with similar interests tend to put themselves into similar types of settings. For example, two people interested in literature are likely to run into each other in the library and form a relationship (involving the propinquity effect). When we notice similar people, we expect them to like us, initiate relationships and create fundamentals of cohesiveness development. Also, having relationships with similar people helps to validate the values held in common. Finally, people tend to make negative assumptions about those who disagree with them on fundamental issues, and hence feel repulsion [45].

Team success:

Team success is driven by the success of each team member. It reinforces the conviction that a team works with high productivity and that each of the team members are an important part of a highly cohesive team. Success, experienced by team members, positively influences the individual motivation, cohesiveness and atmosphere at work. Team members enjoy the feeling of a certain fulfillment and they consider their team and each team member as irreplaceable.

External challenges:

Whenever a team faces obstacles, something that restricts the freedom of actions, the group cohesiveness is challenged. Insufficient resources, unfulfilled assumptions or financial restrictions all put a team on trial. Once the challenges are mastered the same feelings that are felt upon an experience of success emerge, i.e. the feeling of a certain fulfillment and the irreplaceability of the team and each team member.

Somewhat difficult Tasks:

“Somewhat difficult tasks” is how Bloisi named the moderately difficult tasks, to be executed by a team, which may positively impact team cohesiveness in the same way and manner as external challenges, above.

Member interaction:

Team member interaction is defined as a dynamic, accidental sequence of social interactions between individuals (or groups) who modify their own actions and reactions upon the impact of the predecessor actions by the interlocutor. Whenever there are two persons, they usually interact synchronously, i.e. one action causes one interaction followed by the next one and so on. This process is easy to observe and the project manager can intervene efficiently. The interaction is however, more difficult within the typical group of 5-10 persons and virtually only selectively feasible in a team of 30 and more members. We call this fully accidental sequence of interactions an asynchronous one. The project manager can observe the symptoms and eventually notice the unbalanced activity within the team. Whereas synchronous interaction has in general a positive impact on team cohesiveness, asynchronous – and in extreme case – unidirectional actions have a destructive impact on team cohesiveness.

Competition with other groups:

Healthy competition may lead to a highly productive exchange of experiences and the development of team skills. Team members identify themselves strongly with their team and try to achieve the best possible results motivated by the idea of “a strength in unity”. Competition causes that a team strives to achieve the results which exceed their normal performance, as an effect of increased adrenaline and a strong desire to impress other team members with ones’ own quantitative, qualitative or diligent performance. Competition is one of the best tools for building motivation and cohesiveness between team members [43].

Exclusiveness:

An exclusive team was always highly appealing to prospective new team members. It could afford to increase the entry requirements and thus indirectly to enlist more productive individuals. Members of exclusive teams have high self-esteem and care greatly about their membership in this team. They work hard on the permanent improvement of their skills and do their best to win team acceptance and become a cohesive part of their team. The striving for personal performance, however, also bears the danger of unhealthy rivalry within a team. To handle this equilibrium is a challenging task, which the project manager faces.

Factors that affect team cohesiveness and the consequences of team cohesiveness on project management are displayed in Figure 6.

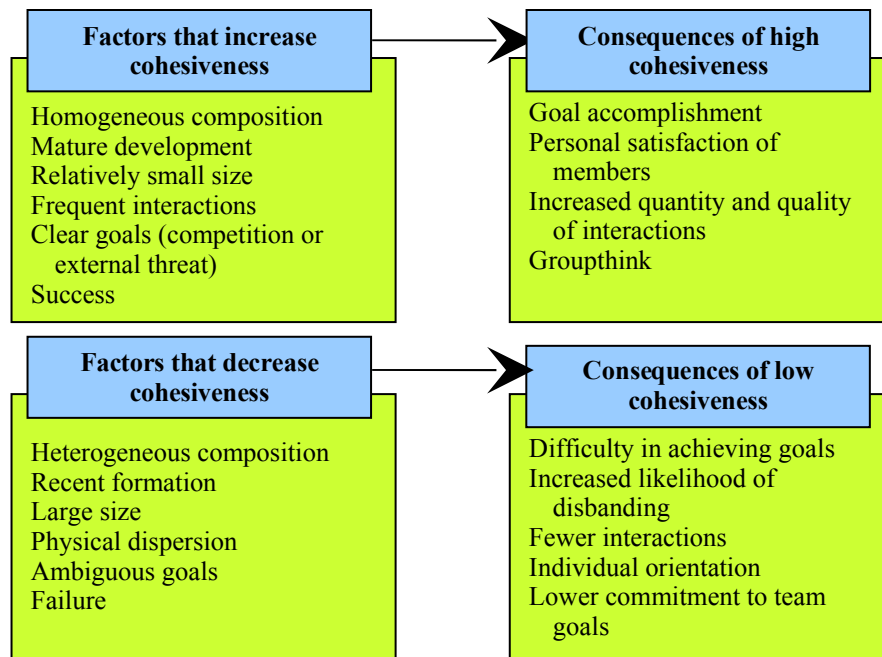


Figure 6. Factors that affect team cohesiveness and the consequence of team cohesiveness

Highly cohesive teams can enforce team norms (exclusivity effect), whatever they are, far more effectively than less cohesive teams. Pressures to conform (internal pressures) are greater. Because people value their membership in cohesive team, they are willing to adjust their behavior to team standards. Even if there is initial "storming" and conflict, if the team "gels," a "norming" period follows and members conform. However, external pressures are greater too. Cohesive team put more pressure on deviants to conform to team norms than less cohesive team do. Compared with members of a low-cohesive team, those in a high-cohesive team will, therefore, be keen to attend meetings, be satisfied with the team, use "we" rather than "I" in discussions, be cooperative and friendly with each other, and be more effective in achieving the aims they set for themselves. The low-cohesive team will be marked by absenteeism, the growth of cliques and factions, and a sense of frustration at the lack of attainment [34].

Indeed, tension within the team has a particular impact on team cohesiveness. The results of the research by Seashore [38], quoted also by Nelson and Quick [31] (Figure 7) let us conclude, that teams with high cohesiveness:

- demonstrate lower tension and anxiety,
- demonstrate less variation in productivity,
- demonstrate improved team member satisfaction, commitment and communication.

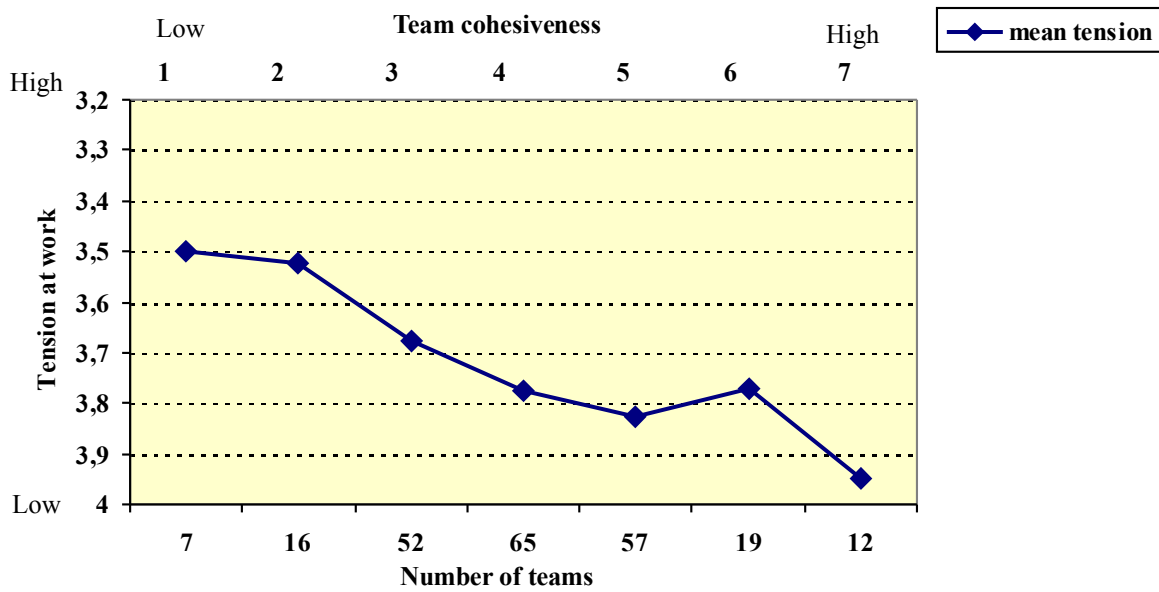


Figure 7. Cohesiveness and Work – Related Tension

7. The positive and negative consequences of high group cohesion

Team cohesiveness is essential to achieving the project goals. However, it may have positive or negative consequences.

In the case of a highly cohesive team with high ethical standards, cohesiveness definitely has a positive impact on team productivity. On the other side, if this team is marked by unethical rules, cheating and law breaking, the more they adhere to each other, the worse and more unpredictable their performances are.

The project manager should encourage team cohesiveness along ethical standards as long as he feels in control. Once the team develops uncontrolled dynamics, cohesiveness may lead to the above destructive developments. The first sign that something has gone wrong (aside from dramatic disasters such as the Challenger explosion) may be that cohesion breaks down and members begin to leave the team without signifying their intentions or even providing an explanation. Team productivity may drop precipitously and outside authorities may be called in (e.g., principals or higher level bosses), while the remaining members refuse to even acknowledge that there are any problems at all.

Losh identified the following positive and negative effects of high team cohesion [22]:

Positive outcomes of high team cohesion	Negative consequences of high cohesion
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<ul style="list-style-type: none"> • Members are more satisfied. • Almost as a tautology, members remain in cohesive groups longer when a choice is available. • Cohesive teams appear to provide a buffer against stress and thus may positively contribute to individual mental and physical health. • Members of cohesive teams less often report feelings of being lonely or isolated. • Identity with the team is stronger in more cohesive teams. • Peoples enjoy membership • Members experience low turnover • Members tend to be highly productive 	<ul style="list-style-type: none"> ▪ Cohesive teams are crueler to deviants. Scapegoating, hostility and aggression are more common toward deviants in higher cohesion teams. • Individual identity may be more stifled and restricted in cohesive teams. Because members are typically closer to one another, they may feel "an investment" in how you look, dress, or talk. If you try to change aspects of your personal identity, even in a positive direction, such as becoming more physically fit, you may find to your surprise that other team members ignore, criticize or otherwise undermine your attempts at improvement. • If team goals diverge from organizational goals, not only may the team as a whole become less productive (by organizational standards), it may also reject members who are productive by organizational standards (e.g., ostracizing the "class brain" or "binging" workers viewed as "over productive.") • Team goals may be damaging, even deadly, to individual members. Remember the loyal German soldiers, the Japanese pilots, and the followers of Jim Jones, who were willing to die for their teams.
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Table 2. Positive and negative consequences of high group cohesion

The main advantages of a cohesive team [4] are:

- 1) *A team quality standard can be developed:* Because this standard is established by consensus, it is more likely to be observed than external standards imposed on the team.
- 2) *Team members work closely together:* People in the team learn from each other. Inhibitions caused by ignorance are minimized as mutual learning is encouraged.
- 3) *Team members are interested to know each other's work:* Continuity can be maintained should a team member leave.
- 4) *Egoless programming can be practiced:* Programs are regarded as team property rather than personal property.

A strong, cohesive team can sometimes suffer from the following two problems:

- *Irrational resistance to a leadership change:* If the leader of a cohesive project team has to be replaced by someone outside of the team, the team members may band together against the new leader. Team members may spend time resisting changes proposed by the new project team leader with a consequent loss of productivity. Whenever possible, new leaders are therefore best appointed from within the teams.
- *Groupthink:* Groupthink [17] is the name given to a situation where the critical abilities of team members are eroded by team loyalties. Consideration of alternatives is replaced by loyalty to team norms and decisions. Any proposal favored by the majority of the team may be adopted without proper consideration of alternatives. Typical symptoms of Groupthink are: invulnerability, inherent morality, stereotyped thinking and views of opposition, self-censorship, peer pressure, mind guards [2].

8. Conclusions

We have seen that most researchers agree on the high and predominant impact of team cohesion on the productivity and performance of a team, thus on the whole software project performance. Furthermore, we have been able to identify the factors that influence team cohesiveness and a few mechanisms that take these factors into account. Nevertheless, we have identified how team cohesiveness bears also dangers and the potentially negative impact on a projects' course as shown above. Therefore, an awareness of the chain of interactions, from single actions, which influence team cohesiveness, through team cohesiveness, up to software project performance as shown in Figure 8:

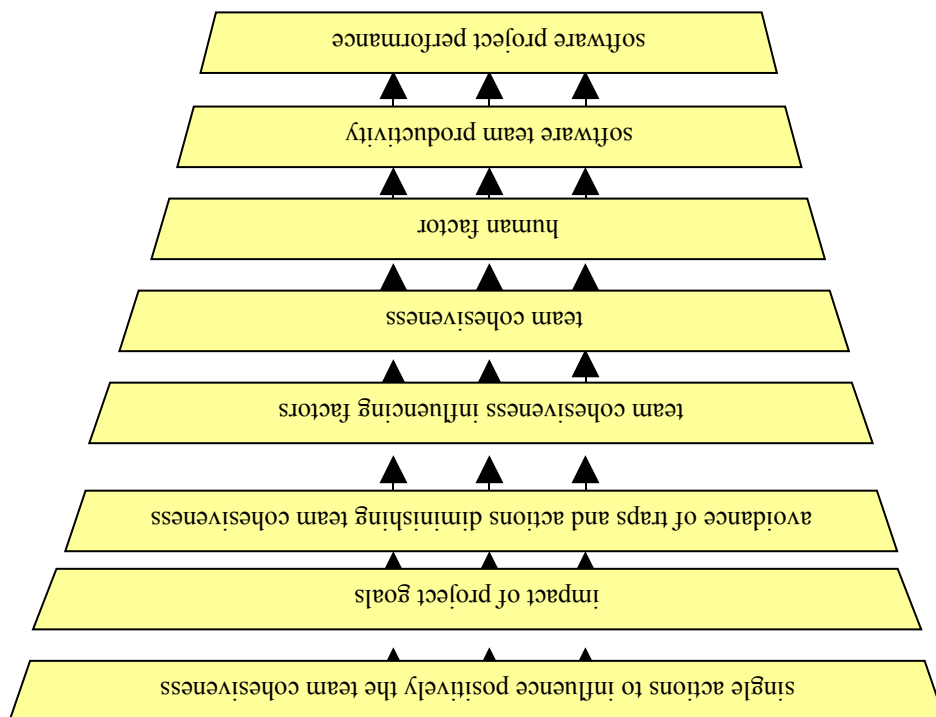


Figure 8. Chain of interactions

may help IT project managers to act consciously and deliberately towards the project goals.

Finally, we can state that the further research and quantification of the relationships undertaken herein has been extremely fascinating because the strong conclusions uncovered are, not only, highly useful to a project manager, but also immediately applicable and timeless for most, if not all IT projects.

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