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Chapter

32

Concurrent Engineering Teams

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Biographical Sketch . . . Preston G. Smith, a Certified Management Consultant, heads New Product Dynamics, a Portland, Oregon, consulting firm that has helped managers in accelerating their new product development for over a decade. He often advises management in setting up development teams and trains and coaches these teams. He is coauthor of *Developing Products in Half the Time,* speaks frequently at conferences on development teams, and has taught product development and teaming techniques at several universities.

Too many product-development teams fail to live up to expectations, actually performing more poorly than their members would have on their own. This chapter provides tools to aid the project manager in setting up an effective concurrent engineering team and avoiding the common pitfalls. Team staffing topics covered include selecting the team leader (who is usually also the project manager); recruiting team members; and dealing with the potential problem areas of part-time members, specialists, and suppliers on the team. The principal dilemma in team organization is that there are many organizational forms, but none is ideal in all circumstances. The trick is in knowing how to select the form that best supports the innovative needs of concurrent engineering—and in avoiding the pitfalls of some impotent forms. Because innovation demands a great deal of cross-functional communication, the emphasis must be on an arrangement that eases team communication.

The Scope of Concurrent Engineering

Although there are many definitions of concurrent engineering, the most common one comes from a military contractor's report:

> Concurrent engineering is a systematic approach to the integrated, concurrent design of products and their related processes, including manufacture and support. This approach is intended to cause the developers, from the outset, to consider all elements of the product life cycle from conception through disposal, including quality, cost, schedule, and user requirements.[1]

Notice that this definition is far broader than just the design of the product and its manufacturing process. It encompasses the product's entire life cycle and includes several broad measures of success, such as cost, quality, time, and user satisfaction. Thus, concurrent engineering actually incorporates much more than just the engineering function in a company.

This definition is not limited to a particular type of product, and it does not specifically mention engineers. Thus, it applies to developing products in which there is little actual engineering. Concurrent engineering may apply to pharmaceuticals, paint, food, or sneakers. By extension, concurrent engineering could apply to developing services, such as insurance policies or trucking, although such applications will require some reinterpretation of the material presented here.

Concurrent engineering teams have the following three key attributes:

1. They must deal with the inherent uncertainties of innovation.
2. A broad range of professional skills is needed, including engineering, science, marketing, manufacturing, and finance.
3. Most of those involved are professional knowledge workers.

These attributes make concurrent engineering teams particularly challenging ones to set up and manage. This chapter focuses on topics that are particularly crucial for teams that develop new products and services.

The Earmarks of an Effective Team

Effective concurrent engineering teams typically have the following characteristics:

- They contain no more than ten members.
- Members choose to serve on the team.
- Members serve from the beginning to the end of the project.
- Members participate on the team full time.
- Members report solely to the team leader, and the leader reports to general management.
- Key functions—at least marketing, engineering, and manufacturing—are included on the team.
- Members are co-located within conversational distance of each other.

Few teams achieve all these characteristics; but teams that work well satisfy many of them and know where they fall short on the others so they can compensate.[2] Figure 32–1 illustrates an ineffective fragmented team having too many lightly involved members.

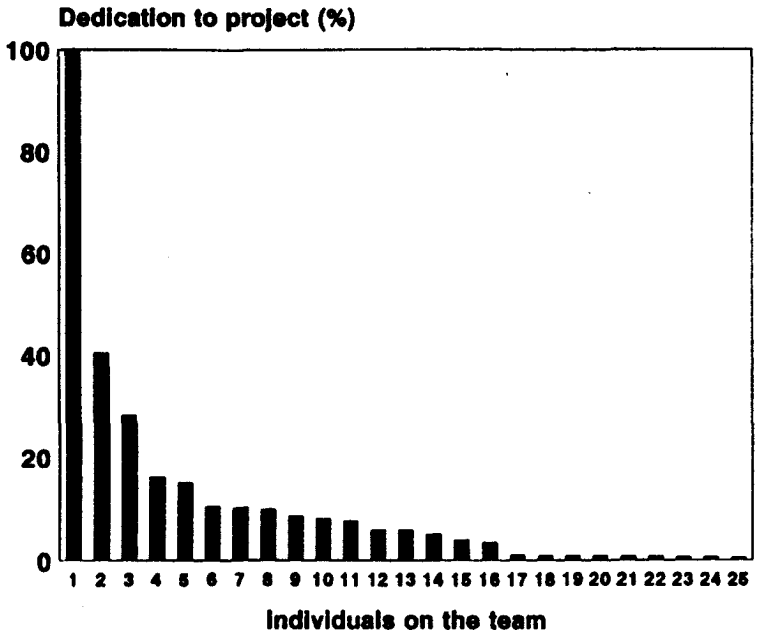

FIGURE 32–1 Ineffective Fragmented Team
Source: Smith and Reinertsen, *Developing Products in Half the Time,* Van Nostrand Reinhold, 1995

A small team (fewer than ten) strengthens commitment and eases communication. Not only is it difficult to communicate in a large group, but it is also hard to keep track of everyone's opinion and reach agreement. Note that the requirement for full-time membership naturally keeps the team small. If size is still a problem, the techniques of incremental innovation or product architecture can divide the work among smaller teams.[3] This is just what Boeing did when developing its 777 aircraft. The company divided the work among 238 design-build teams.

End-to-end continuity overcomes the communication and accountability gaps that follow from passing the project "over the wall" to the next group. Full-time involvement also clarifies accountability while simultaneously clearing people's slates so that they can concentrate heavily on this one project.

Reporting relationships are crucial, because to make fast cross-functional business decisions, the team must regard itself as an empowered business team, not just a group of functional representatives or a band of engineers.

Being co-located is another technique to greatly accelerate and raise the reliability of communication. This in turn improves problem solving and decision making, which are both core activities in product development, Because physical proximity of team members is a great asset to a team, it is worth the extra effort required to obtain it. Professor Thomas Allen of MIT provides the

best analytical case for co-location. Figure 32–2 is a composite from several research and development labs investigated. It shows that people are far more likely to communicate when they are within conversational distance (closer than ten meters, or thirty feet).

However, the strongest case for co-location comes from teams that have tried it. There is no substitute for the way it enhances and speeds up communication. Those who have been on co-located teams would definitely choose it again if they had to get a new product to market quickly. Just as a real concurrent engineering team includes other functions, such as marketing and manufacturing, real co-location involves more than just the engineering members of the team.

As powerful as it is, co-location is not easy to accomplish in many organizations. Many development teams are dispersed among several sites, sometimes even on different continents. This makes co-locating difficult to impossible. Even for teams in the same metropolitan area, the obstacles include the following:

- Lack of sufficient floor space
- Concerns about distractions or lack of privacy
- Functional bosses worried about losing control of "their" people
- Perceived lack of status
- Lack of a permanent office home

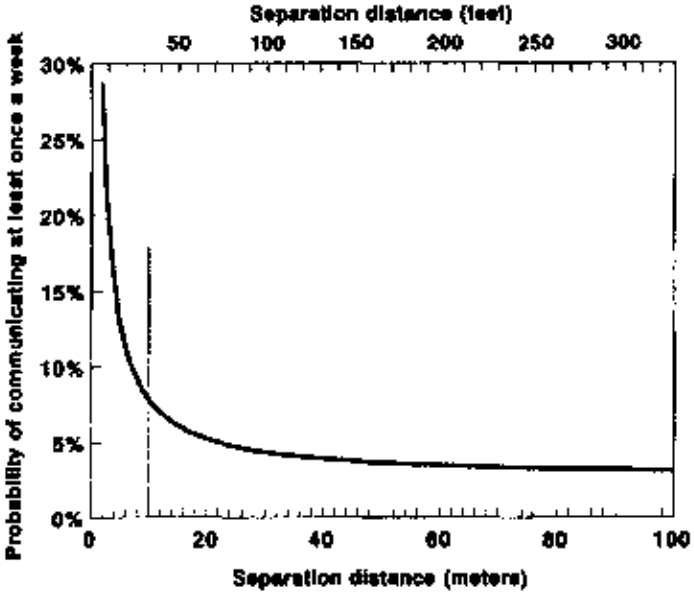

FIGURE 32–2 Probability of Communicating at Least Once a Week
Source: Allen, *Managing the Flow of Technology,* The MIT Press, 1977

Some people, especially in high-tech industries, claim that modern communications have superseded the need for co-location. But has voice mail (and phone tag) really made telephone communication any faster or more reliable that it was twenty years ago? E-mail allows one to broadcast messages more efficiently than before, but does that ensure that they are read, understood, or acted upon? Face-to-face communication remains by far the highest-quality medium for conveying many types of information and receiving accurate, fast responses. Thus, co-location is far from obsolete.

Each organization will have different difficulties in satisfying the characteristics that will make the team effective, but the biggest difficulties often provide the most opportunity for improvement. In highly hierarchical organizations, where the only general manager is the person at the top, it seems virtually impossible to have all development teams reporting to this CEO. Another company that has operations all over the globe may deal well with the general manager problem but have a great deal of difficulty with co-location. In companies that simply have too much on their agendas,[4] full-time involvement may be unthinkable.

TEAMS AND MEETINGS

Teams often get associated with meetings. Some teams form to solve problems or make decisions. For these teams, the team's work is done in meetings. However, a development team's job is to do things, things such as design, analysis, customer visits, prototype building, and testing. These tasks do not get done in meetings. So if team members think of their roles as holding meetings, little will get done, people will arrive at meetings unprepared, and progress will be slow. A development team should not define itself through its meetings, but rather as a group that completes the value-added tasks that breathe life into a new product.

Staffing a Team

Often, the team leader and the project manager are the same person. These two roles fit well together, and they provide some latitude in choosing a title that reflects the desired emphasis. The title should answer the following question: Are we looking for leadership or management? Is the object of this attention the project or the team?

It is when the project manager and the team leader are different people that difficulties can occur. If the project manager reports to the team leader and has little authority, this role can degrade into one of administrator. The project manager keeps the schedule and budget up to date but has little power to take action on the information he or she maintains. On the other hand, sometimes the team leader role is held by an executive who spends little time with the team. Then there is an ineffective absentee landlord situation.

The choice of team leader is the most important one management will make in the life of the project. A project to develop even a simple new product will have to overcome many obstacles because of the product's innovative

nature. A weak leader will be unable to deal with the hurdles, so management will get drawn in, which simply is a slow way to run a project. Rapid progress depends on a readily available leader/manager with a can-do attitude who takes charge when difficulties arise. A part-time project manager or team leader is not sufficient. If management assigns anyone to the project full-time, it should be the leader.

The team leader should be considered first as a general manager, not a functional expert. The real skill needed is to integrate the marketing, engineering, manufacturing, and other departmental viewpoints into a solid business direction. If the leader is viewed as, say, primarily an engineer, then functional managers of marketing and other departments will feel obliged to get involved to protect their interests. This outside managerial involvement undermines the very advantage a cross-functional team can provide, which is fast, effective action on cross-functional issues.

TEAM-LEADER SKILLS

Two groups of essential skills underlie this general management capability: product-vision skills and people skills. A popular definition of leadership is the ability to transform vision into results. If this is the case, then to get a winning new product to market, the leader must have a broad, integrated, and focused vision of the product and be able to communicate this vision to others.

The need for people skills is probably obvious, but most of these skills stem from innate ability or long-term development; seldom can they be trained-in as needed. Such skills include the ability to do the following:

- Incorporate diverse views, especially from quieter people or on unpopular subjects.
- Resolve conflict.
- Develop members' skills and their confidence in them.
- Intrinsically motivate members.
- Move ahead with little or unclear authority.
- Obtain the human and other resources needed.
- Protect the team from outside distractions.
- Maintain a relaxed atmosphere under stressful conditions and employ humor effectively.

Clearly, the leader needs a working knowledge of the technologies and other professional disciplines involved in the project, but in-depth knowledge can get in the way by encouraging micromanagement. The team will also need conventional project-management skills, such as an ability to run effective meetings, schedule and monitor progress, draft and manage a budget, and comply with the corporate procedures on product development. Such skills are usually secondary in importance and can be learned on the job when necessary. The practice that many companies have of always selecting team leaders from a certain department, such as engineering, just places a misguided restriction on the search for a good leader. Engineers do not have a corner on the crucial vision or people skills.

TEAM MEMBERS

Effective team members have qualities remarkably like those of good leaders.[5] In particular, members should be self-starters who can work without supervision. Another essential attribute is a willingness to think independently and support contrary views when necessary. Groupthink is particularly destructive in a close-knit team whose job is to innovate.

In selecting members, the leader naturally makes sure to incorporate the key disciplines and professional skills—the so-called hard skills. However, there is another set of critical soft skills that is just as important to have available within the team. These skills include problem solving, idea generation, conflict resolution, and negotiation.

One earmark of successful teams is that members volunteer to serve on the teams. Given the hectic pace in industry today, it is unlikely that people will actually volunteer, but it is important that they are on the team because they want to be.

How does one recruit such volunteers? First, the team leader, who does the recruiting, identifies the people desired on the team. Then the leader goes to management and negotiates the availability of the desired individuals. In some cases, management can accommodate the leader, and in others the individual involved will be too critical to another project.

Then the leader discusses with the prospective member, in an honest and evenhanded way, the pros and cons of being on the team. The leader then watches and waits: Is the prospect excited about the possibility or does he or she raise objections? It will become apparent at this point whether the prospect chooses to be on the team. If not, the leader should look for someone else; this person is unlikely to put forth his or her best for this team.

HEAVY EARLY STAFFING

A common mistake made in staffing a team is not getting key players on board soon enough. Early staffing may be weak as new members finish prior commitments so that they can join the team. The team then gets off to a shaky and slow start, which puts it in a catch-up situation from the outset. When the late members do join, they are at a disadvantage, because they have not participated in the preparatory activities and early decisions. Quite simply, slow ramp-up sets the stage for failure.

Usually, when the objective is minimum cycle time, teams are understaffed throughout their lives.[6] Starting off understaffed just ratifies this unacceptable situation. Project launch is the time for the team leader or project manager to be most adamant about full staffing, because early shortfalls are likely to become the norm later.

For concurrent engineering, the late arrival of downstream players, such as those involved with manufacturing and field service, just perpetuates a situation in which products are not designed for manufacturability and serviceability. The only way to break this continuing stream of unmanufacturable products is to get the downstream functions involved at the outset.

THE POWER OF GENERALISTS

Ever since Frederick W. Taylor and Henry Ford, U.S. industry has encouraged labor specialization. In many cases, this is with good reason. Individuals feel good and can command better pay by doing something specific a bit better than others. In addition, organizational design is cleaner, because one can put people in definite pigeonholes and put precise labels on the organization chart.

Unfortunately, specialists create a host of problems on a product development team. It is difficult to keep them gainfully occupied full-time on the project, so they' come and go from the project as it needs their expertise. This creates scheduling, availability, and delay problems, which ultimately stretch the schedule. The specialists often feel little commitment to the project at hand. They are unlikely to understand well the project objectives, such as the product attributes the customer values most. Nor are they apt to comprehend how their work must fit with downstream activities, such as manufacturing, distribution, and promotion.

Thus, on balance, a development team can move faster and produce products that satisfy customers better by using a few generalists working full-time throughout the project. Clearly, there is limit to how far one can go with generalists, because a company's competitive edge often depends on the distinct competencies that specialists provide. Yet, most firms would be much better served by shifting toward generalists on development teams. Ultimately, this requires favoring generalists through recruiting, compensation, training, recognition, and promotion.

Until these long-term measures create more generalists, team leaders should seek generalists—or those willing to try wearing different hats—when recruiting team members.

SUPPLIERS ON THE TEAM

Many companies, especially automobile manufacturers, are providing substantial roles for suppliers on their concurrent engineering teams. Supplier involvement is important in three situations. First is when the supplier's lead time is long or unpredictable, which can delay the whole project. Second is when the supplier's ability to manufacture the parts reliably and with high yields depends on the design that the team supplies. The third situation is when the supplier holds a special knowledge of a product technology that is critical to success.

In these cases a supplier should be a substantial member of the team. The critical item to manage here is getting the supplier involved early, when she or he can contribute to shaping the critical early decisions that will add value to the product. It is virtually impossible to get the supplier involved too early. Once the supplier is on board, project managers should keep in touch with that person on an ongoing basis (weekly), even when there are no important issues to discuss. This will keep the project manager up to date on the supplier's workload and thus the supplier's ability to respond when needed by the team.

Substantial supplier involvement means that the supplier spends time onsite with the team, often co-located. Clearly, the supplier should receive equitable compensation for this, perhaps with upfront payments for his or her time, rather than having compensation amortized in the piece-part price later. This type of in-depth involvement carries its price, so project managers will want to select carefully the few suppliers whose contribution will warrant this special treatment.

TEAM TRAINING

Many teams succeed without training, but training of an intact team gets the team through its initial forming and storming stages quickly. This is especially true for a firm's pioneering concurrent engineering teams.

Two types of training are valuable. One relates to the soft team skills, such as defining roles and responsibilities, understanding the variety of personality types on the team and how they typically react, building trust, and resolving conflict. The other is the harder, more content-oriented skills, such as the techniques of rapid development, how to make customer visits, and how to use tools like quality function deployment effectively.[7]

The effectiveness of this type of training decays quickly, so it is best done exactly when the need occurs. Thus, advance planning and budgeting are essential to line up the training sources and have them available for timely insertion. Some types of training, such as conflict resolution, are more difficult to plan for. Consequently, having a trainer or facilitator on staff and accessible is of great value, especially for the softer skills.

MOTIVATING THE TEAM

This is a highly controversial subject with few clear answers. It is also an important subject, for it relates directly to individual and team effectiveness. The following are a few guidelines that apply especially to concurrent engineering teams.

Project managers should think beyond financial rewards. Although coffee mugs and T-shirts may have seen their day, there are many other options available to the creative team leader. For example, consider a photo of the team in the annual report, lunch with the executive sponsor, or a holiday weekend.

A preoccupation with financial motivation usually indicates something askew in the basic compensation system that patchwork rewards will not correct. People deserve fair compensation for the work done regardless of whether they are on a team.

Project managers should think carefully about the change in behavior they want, and plan motivation and rewards to encourage it. For example, recognizing individuals, just the team leader, or a core part of the team does not encourage teamwork.

Project managers should not depend heavily on rewards or other types of extrinsic motivation for obtaining results. There are just too many ways in which they can backfire. People will resist attempts to be controlled by rewards or money.[8]

Organizing a Team

Although there as many types of organizational structures as there are organizations, most of them fall somewhere on the spectrum from a functional organization (Figure 32–3) in which each person reports to a function manager to the stand-alone team (Figure 32–4), in which individuals involved in the project report directly to the team leader, who in turn reports to a general manager. Between these two ends lie a variety of options in which an individual reports simultaneously to a functional manager and a team leader. (See Chapter 14 for more information on matrix forms.)

Each of these forms has its strengths and weaknesses. The functional form is popular in industry because it has provided functional strength and expertise for years. However, in the functional form, communication and decision making tends to flow through the functional heads. This is simply not very effective for the heavy load of cross-functional communication entailed in product development. Decisions get made much better and faster with a more horizontal form.

Consequently, there is no one best form, and the one to use depends on the objectives of the particular project. Some projects developing highly innovative products can benefit greatly from the horizontal flow prevalent in the more autonomous forms. They are willing to tolerate the shortcomings of poorer functional coherence. For example, they may let designers on every project team select a different type of fastener, which ultimately causes factory complications. In contrast, for a more routine product upgrade project,

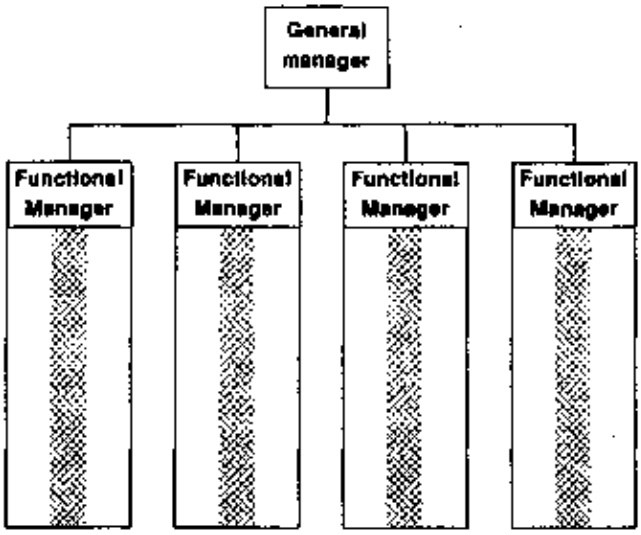

FIGURE 32–3 A Functional Organization
Source: Smith and Reinertsen, *Developing Products in Half the Time,* Van Nostrand Reinhold, 1995

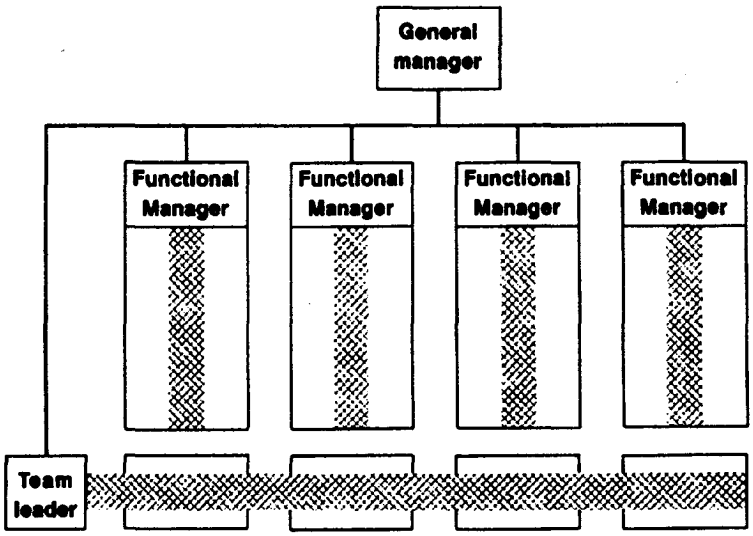

FIGURE 32–4 A Stand-Alone Team Structure
Source: Smith and Reinertsen, *Developing Products in Half the Time*, Van Nostrand Reinhold, 1995

the balance can be completely different, which suggests a different organizational form. The most effective teams design their organization to fit the job rather than just adopting the company standard.

Once the organizational form is selected, project managers should recognize its weaknesses and be sensitive to them. For example, if proliferation of fasteners is likely to be a problem, put some type of fastener standards or coordinating mechanism in place.

As companies remove layers from their hierarchies, they generally move toward more horizontal forms, which is generally in the right direction for development teams. However, this shift is not likely to be fast enough for the needs of an innovative development project. Thus, a concurrent engineering team may be in the position of pioneering new organizational forms in a company.

Just putting some people together or having a meeting, however, does not make a team. Real teams require real effort to set up and maintain, but they pay real dividends, too. The biggest mistake many project managers make is in assuming that a team will just happen.

ENDNOTES

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