Human Side: Team Work

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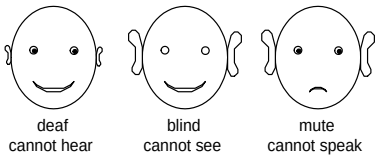

but in the team two can hear,
two can see, and two can speak

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Abstract

The creation of products requires many different people to cooperate. The work is often organized in teams. The team members have complimentary skills and knowledge. In many management courses the need to design teams is emphasized. Unfortunately, often these recommendations are ignored. We re-iterate in this paper the rationale for teams and the recommendations for designing the team itself.

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1 Why Work in Teams?

Today's product creation projects involve so many fields of expertise that we need many different specialists. Teams are a way to organize the project. From management perspective manageability is one of the main reasons to use teams.

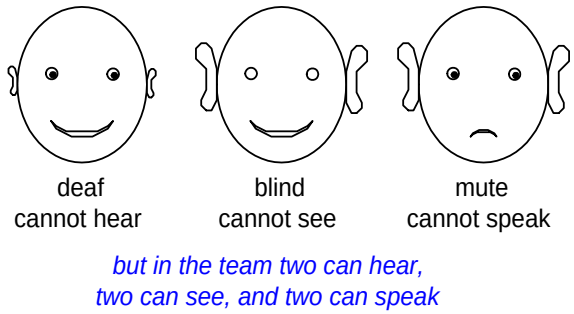

Figure 1: Teams consist of peoples with complementary skills and knowledge

Teams can also be an effective way to benefit more from the strengths of individuals within in a group. A well designed team is more than the constituting members. Figure 1 shows a schematic version of the figure of the three apes, where one ape cannot see, one ape cannot hear, and one ape cannot talk. If all three team-up, then we have a team where two apes can see, two can hear, and two can talk. The team members are complementary and jointly they can do much more than every individual alone.

2 Team size

Teams can vary from very small (two people) to very large (thousands of people). However, large teams are often further divided in smaller teams, since human interaction gets more difficult with more team members. For example, an entire project is decomposed in subsystems and further decomposed in components, where the team organization follows the same decomposition.

In practice only small team, e.g. between 3 and 8 people, show intense interaction. When teams are bigger, the team de facto divides itself further to "human" scale teams. Figure 2 shows that large organizations are broken down in smaller units. It also shows that the size impacts the housing and location of teams.

The operation of a team depends strongly on its size. Very small teams of two or three people will interact more intense and informal than larger teams. Larger teams will need more time to communicate, lowering their efficiency. In fact every increase of the organization size with circa 50% triggers changes in the mode of operation.

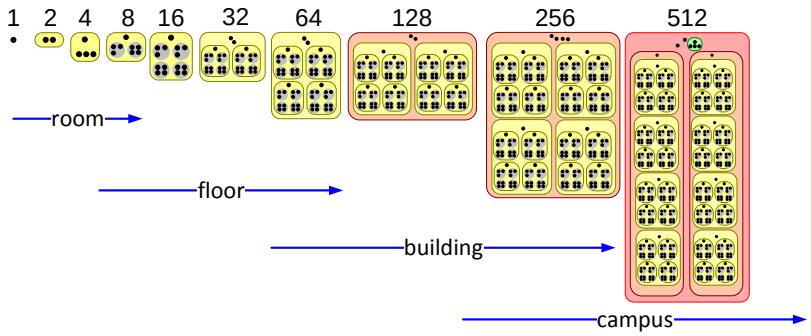

Figure 2: The way of working of a team depends on the team size. Every factor 2 in size creates a different paradigm.

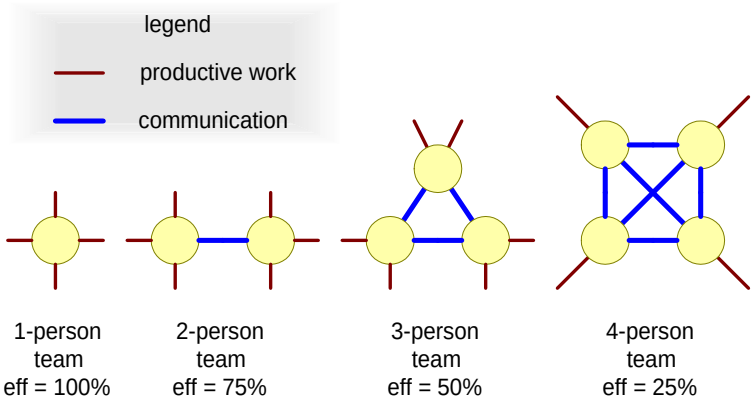

Figure 3: Very simplistic model of team communication and productivity

Figure 3 shows a very simplistic model of the communication and the productivity of a team member. Every team member is modeled as being able to spend time on 4 tasks each 25% of the time. Every task is either producing something or communication with someone. This simple model shows that working with more people gets quickly less efficient due to communication overhead.

This simple model can be transformed in a hierarchical team model, see 4. The hierarchy reduces the communication overhead, and hence improves efficiency. Note that the hierarchy increases length of the communication paths. Longer communication paths suffer from more latency and more deformation. Efficient organizations tend to combine a hierarchical structure with more direct communications between individuals, creating a network organization.

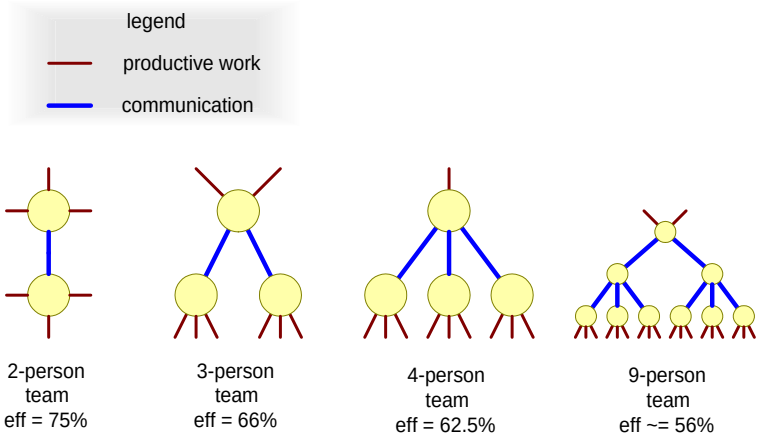

Figure 4: Very simplistic model of team communication and productivity with hierarchy

3 Team composition

A good team consists of complementary members, where the members can cooperate well. The team "chemistry" must be good. In the literature many role models are given that can be used to "design" a team.

plant creative	*team worker* cooperative, averts friction	*implementer* disciplined, conservative, doer
resource investigator enthusiastic communicator	*shaper* driver, dynamic	*completer finisher* conscientious, painstaking
coordinator mature, chairman	*monitor evaluator* sober, analytical	*specialist* single-minded, rare skills

Belbin's team roles

Figure 5: Belbin team roles

Figure 5 show the roles described by Meredith Belbin [2] See for a summary of these roles [1]. People tend to have preferred role patterns that they follow. This is not black and white, people can be mostly plant and somewhat of a chairman at the same time. The idea is that a good team needs all different roles.

Another role model is provided by Edward de Bono [3], the so-called *Six Thinking Hats*. These colored hats symbolize the natural attitude that persons bring into the team. Figure 6 shows the six different colors and their main characteristics. Again the idea is that these different kinds of people are complementary, a

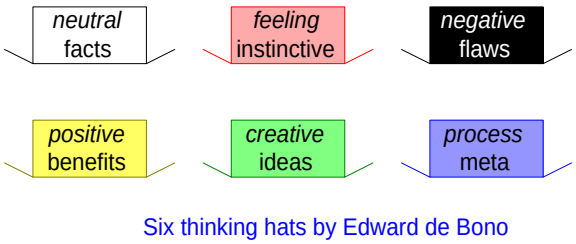

Figure 6: Six thinking hats by Edward de Bono

team needs positive and negative oriented members, creative and process oriented members, and neutral and feeling oriented members. Also note that some members can take on all colors: chameleons.

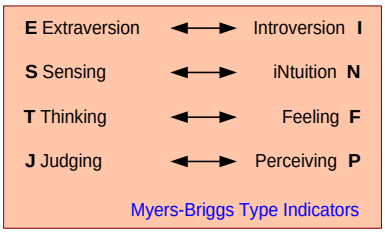

Figure 7: Myers-Briggs type indicators

A famous ontology is provided by the Myers-Briggs type indicators [5]. Four characteristics with their two extremes are used as parameters to classify people, following Jung's ideas with similar characteristics. In Figure 7 these four characteristics are shown: *Extraversion* and *Introversion*, *Sensing* and *iNtuition*, *Thinking* and *Feeling*, and *Judging* and *Perceiving*. Someone's personality type can be captured by concatenating the 4 letters of these characteristics. For example, it is often observed that systems architects have INTP as personality, see for instance `http://www.e-mbti.com/intp.php`.

To design a team the roles/personalities of its intended participants have to be taken into account. However, we also have to design the team to get:

- a multitude of opinions
- coverage of the involved stakeholders
- coverage of knowledge and skills

4 The Process of Creating and Employing a Team

Let us assume that someone in the organization, for example the business manager or project leader, has the need for a team. We will call this person the team owner, meaning that this person feels responsible for a good functioning team and has a need for its results. Figure 8 shows this team owner at the top of the figure.

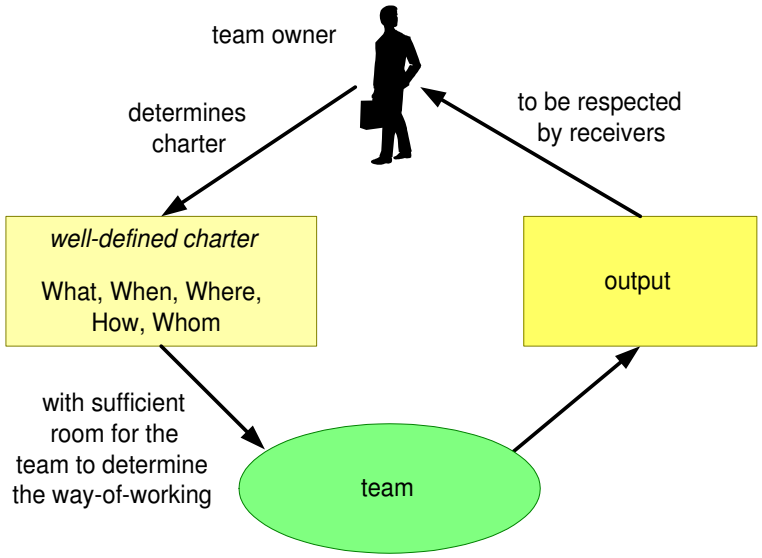

Figure 8: Process of creating and employing a team

This team owner will compose the team as described in 3, will arrange facilities, such as housing as described in 5, and will have to provide a charter for the team. A charter provides the scoping for the team: *what* has to be done*why*, *how* to achieve this, *whom to involve*, and *when* and *where*. This charter gives direction for the team. However, the team should be able to determine its own way-of-working within the charter. Micro-management of the team by its owner or others outside the team will greatly reduce the team's productivity. In other words the team has to be empowered by the owner.

The team will produce results while working. These results have to be respected by the receivers, such as the owner. If the results are not respected, then this will discourage this team and also the successive teams: *Why engaging in team activity, if the results are not taken seriously?* The owner should consider this aspect before initiating a team. Teams might reach conclusions that are undesired by the initiators. Sometimes, teams are initiated as decoy rather than a real goal; this works once, after that employees are frustrated and it takes a long time to repair trust and motivation.

5 Housing and Location

Housing can be used as instrument to boost team productivity and cohesion. When team members sit in one and the same room, then they will communicate more frequently and more natural.

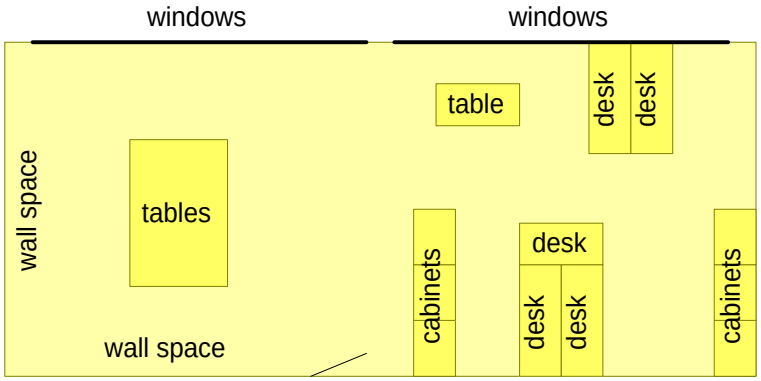

Figure 9: “War Room” is very effective

Figure 8 shows an example of a room used by the systems engineering team that designed the next generation wafer steppers at ASML. This large room had space for the normal desks with PC’s, and a meeting space with plenty of wall space. The wall space can be used for white-boards, flip-overs, and large format print-outs of diagrams. This type of war room is very effective.

Housing is an effective means to improve team efficiency. There should not be any obstacles, such as distance, to let team members communicate. The room described above also supports communication by providing wall space and simple means to share visualizations. In LEAN product development also the physical system or the components are shared in the same location, supporting tactile and visual discussions. In a Concurrent Design Facility the room facilitates sharing of computer based models by using multiple large screens for projection.

6 Concurrency

Organizations seem to increase the number of activities continuously. Individual employees get more and more activities they have to do, often more or less concurrently. These activities tend to fragment the time of individuals, working a little on the first activity, do something on the second activity, continue with the next, et cetera. Figure 10 shows this fragmentation. It also shows that working in burst mode, e.g. working focused for one day, one week or one month on a single activity can be more efficient, because less context switches are required.

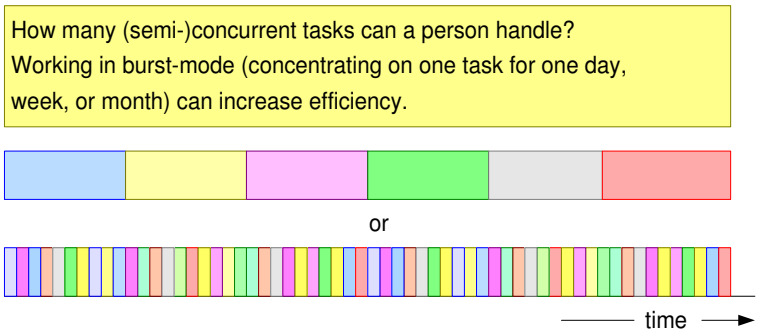

Figure 10: Many engineers have to divide their attention over a multitude of activities

Figure 11 takes this line of reasoning further. It shows six activities that are being executed in parallel and the same activities, but now executed sequentially. When the activities are done in parallel, then the results of all activities become available when all work is finished. When the activities are performed sequentially, then the first result gets available after one sixth of the time of the parallel approach. This means that the result itself, and feedback on this results becomes available much earlier. In other words, when working in parallel all results are late.

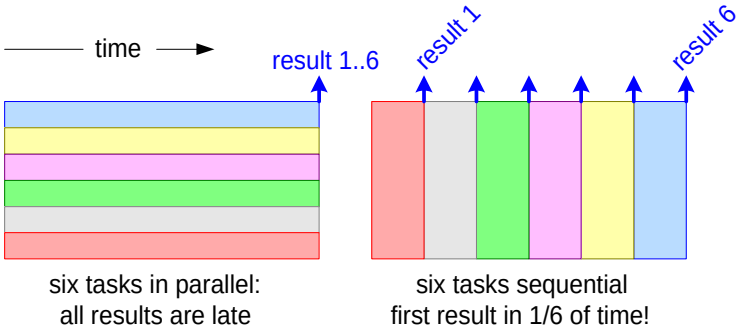

Figure 11: It can be more efficient to do activities sequential rather than parallel

Figure 11 is a simplification of reality. It might be that some activities need to be parallel, for example because of the inherent elapsed time of the activities. Nine mothers cannot deliver one baby in one month, although nine mothers can deliver nine babies in nine months.

If we map these consideration on teams, then we should realize that in practice people, and certainly systems architects, participate in multiple teams at the same time. An example is shown in Figure 12.

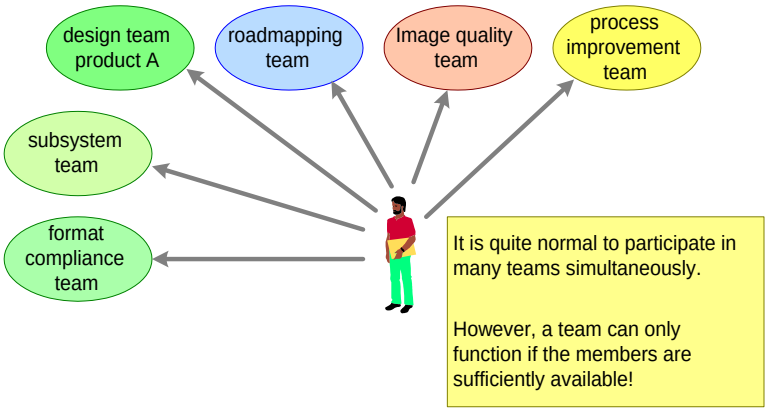

Figure 12: One person will be member of multiple teams

The systems architect in Figure 12 works on the creation of a product, and is part of the *design team* of that product. At the same time the architect participates in more specific teams of that product creation, such as one of the *subsystems* and some specific aspects such as *format compliance*. However, the system architects will also participate in broader concerns of the organization, such as *image quality*, *roadmapping*, and *process improvement*.

If all these activities run concurrently, then some of them might suffer. For example, it might be better to focus for four weeks entirely on roadmapping together with the other roadmapping team members, and after that time continue with the day-to-day architecting concerns of the product creation.

7 Critical success factors

Figure 13 shows a summary of the critical success factors that we have discussed.

well defined charter for the team: *what*, *where*, *when*, *how*, *whom*

clear owner of the result Who needs the team, who ensures appropriate support and facilities, who is worried when the team hits obstacles?

respect for the output of the team The team with all its expertise might draw unwanted, undesired conclusions. The output of the team has to be respected, otherwise follow-up teams will not be motivated.

freedom of way-of-working The owner has to empower the team, micro-management will stifle the teams effectiveness.

housing and location are instruments to forge a team, co-location in a war room is recommended.

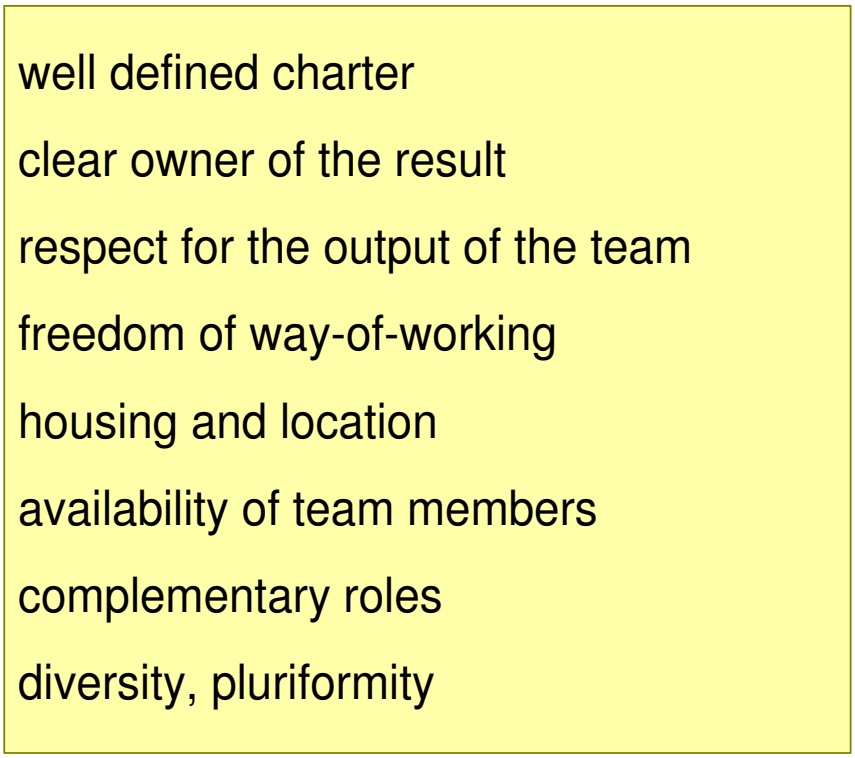

Figure 13: Critical Success Factors for teams

availability of the team members is a prerequisite to work as a team. The availability can be arranged by careful preparation and clear allocation of team members.

complementary roles so that the team is more than the sum of the individual participants.

diversity, multitude of opinions Some controversy or tension in the team is healthy to prevent inbreeding and blind spots.

8 Acknowledgements

Ben Spierenburg showed me very long ago the simplistic model of team communication and productivity. The sequential versus concurrent tasks diagram was shown to me by Philips Organization and Efficiency department.

References

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- changed status to draft

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- Added text
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