




# Model of Characterization of Teamwork Competence Based on Three Types of Capabilities

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**Abstract.** There are various teamwork models with different orientations regarding the conceptual model, member involvement, evidence management, and even the training process for acquiring teamwork-related skills. This research defines a hybrid model that integrates the two main theoretical models (focused on group achievements and team member involvement) and an open-box method (with continuous generation and verification of both group and individual evidence). Therefore, teamwork competence is associated with a set of capabilities of different types, classified into three main categories: group, individual, and general (soft skills), which are related to teamwork but not exclusive to it. This paper also presents the evidence that allows for continuous and transparent training and evaluation of these three types of capabilities.

**Keywords:** Capabilities · Competencies · Evidence · Teamwork · Theoretical models · Training models

## 1 Introduction

The concept of teamwork refers to the process in which different people collaborate to achieve a common goal by utilizing the skills and competencies of each individual to achieve an outcome superior to what they could achieve individually [1–3].

In the current labor market, alongside other transversal competencies such as Critical Thinking, Communication, or Emotional Intelligence, Teamwork is among the most in-demand skills across various fields [4–6]. Especially in complex, hazardous tasks or those requiring high reliability, such as medical, construction, or business environments, achieving objectives optimally increases motivation and creativity. It allows for efficient management of a group of people [7–9].

For teamwork to be effective, efficient, and satisfactory, it is essential to identify the key skills and capabilities that each team member can contribute to ensuring the team's proper functioning [10]. Distributing work among team members based on their potential is crucial for achieving objectives, preventing demotivation, and avoiding the risk of the team's breakdown, particularly in activities or tasks where solitary work predominates [11–13].

In an academic context, when students engage in teamwork, the teacher has two objectives: that students work together to achieve a result and acquire the skills that define the competency they will later need in the professional world [14]. It is necessary to ensure that each member has acquired the necessary skills, and there are different models of teamwork for this purpose.

Some of these models focus on the teamwork process itself, analyzing its evolution for a set of group capabilities (linked with the competence that allows the team to progress). Others focus on the individual skills that team members must possess for the team to progress properly. Both types of capabilities must be considered, as a group capability (e.g., planning) may be correctly achieved, but some team members may not have participated in the process. Therefore, both approaches must be integrated, forming and assessing both group and individual capabilities.

Moreover, there are other capabilities, such as commitment, responsibility, willingness to collaborate, and empathy, which, although not exclusive to teamwork, are desirable qualities in any work or action. In teamwork, these soft skills are crucial to effectively carrying out tasks [15, 16].

Traditionally, teamwork models only validate either the team's evolution or the individual's evolution within the team. However, the training and assessment method for acquiring teamwork competency is crucial for verifying, assessing, and validating the acquisition of related capabilities and soft skills.

In this context, the most commonly used training methods are “closed box” types, which evaluate the acquisition of teamwork competence once the work has been completed. However, for training to be effective, it is necessary to verify the acquisition of competence during the development of teamwork, not just at the end. For example, if assessed only at the end, a member may not have worked at all and, therefore, not acquired any associated capability. The “open box” method allows for real-time detection of each person's work progress, ensuring that all students work equitably and consistently [17, 18].

This research defines a hybrid teamwork model that integrates the team-focused model, the member-focused model, the open-box training method, and shared leadership (all team members perform leadership tasks). The aim of this work is to define this hybrid model and validate it in a university context to identify specific capabilities (both group and individual) and the evidence from which indicators to measure these capabilities are obtained.

In the following section, the hybrid model will be described in terms of its components, followed by a description of the application context of the research, and finally, the results and conclusions.

## 2 Model

The proposed hybrid model integrates a team-focused model, which specifies the group capabilities a work team should have, and a people-focused model, which specifies the capabilities individuals need to participate in a team.

Additionally, the model is combined with a training method for acquiring teamwork competency. This is crucial for training, monitoring, and achieving soft skills and validating the acquisition of these capabilities.

Figure 1 shows the work's theoretical framework, identifying the capabilities associated with the team, the team members, and the training method. The following subsections explain the three categories of capabilities.

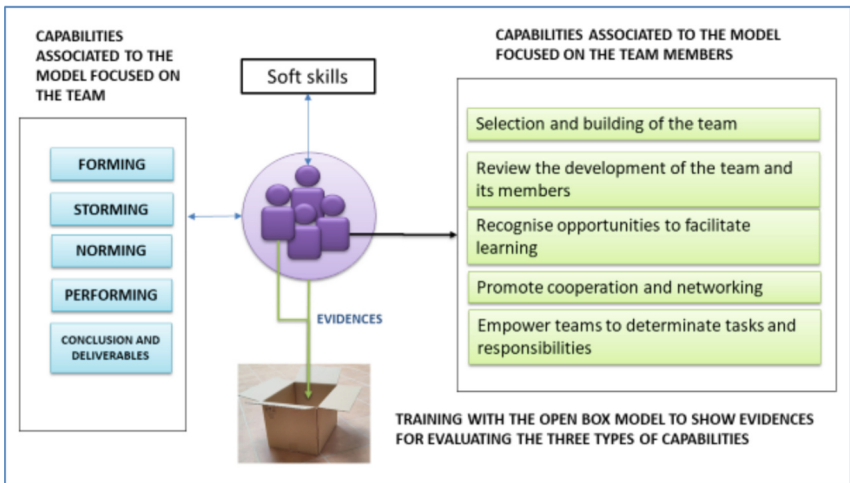


Fig. 1. A proposed hybrid model for teamwork

### 2.1 Team-Focused Model

The model focused on the team used in this proposal is Tuckman's model [19], which is based on the team's evolution, meaning that a set of evidence is analyzed to determine whether the team is functioning properly. If the evolution is correct, the work will be completed on time, within scope, and within the assigned budget (in the academic context, this refers to the expected effort). Tuckman's model suggests that a team evolves through well-defined phases:

- *Forming*. The phase where the team is created and its members are included.
- *Storming*. The phase where members get to know each other and define the scope and objectives of the work.
- *Norming*. This is the phase where the team clearly understands each member's goals and capabilities and defines what each person must do. The team also establishes the rules that will govern the teamwork.

- *Performing*. This is the phase where teamwork is executed normally and optimally.
- *Conclusion and deliverables*. This is the phase where the team meets its objectives and delivers the final work results, temporary documentation, and lessons learned. In Tuckman's original model, this phase was called "Adjourning" and signified the end of the cycle or the team's dissolution. Later, it was redefined as a phase that captures the team's experience to benefit future teams or improve the results obtained.

Each team member's skill level is what certifies their ability to progress through the various phases.

## 2.2 Member-Focused Model

This approach is based on the idea that members must acquire specific capabilities to work effectively in a team, and without them, the team cannot function properly. Therefore, it focuses not on the team's evolution but on the members' skill development.

The model used is the IPMA model [20, 21] for agile methodologies, which identifies a set of key indicators of teamwork competency. These indicators define the skills that individuals must have:

- Facilitates the selection and building of the team.
- Promotes cooperation and networking between team members.
- Supports, facilitates, and reviews the team's and its members' development.
- Empower teams to determine tasks and responsibilities.
- Recognizes opportunities (including errors) to facilitate learning and continuously inspires the team to improve.

## 2.3 Training Method

In addition to working with group and individual competencies, the training method also addresses other general capabilities based on soft skills. The training model is an "open box," relying on evidence's continuous and progressive contribution. The evidence corresponds to member-centered models, teamwork-related evidence, and soft skills.

This evidence is accessible at any time to both team members and instructors. This model allows the instructor to conduct continuous and formative teamwork assessments, enabling corrective actions to ensure competency acquisition.

The training model is combined with a version of the active learning method, the Flipped Classroom, which includes both online and face-to-face activities.

## 3 Context

The research was conducted during the 2022–2023 and 2023–2024 academic years in a first-year course of the Biotechnology Degree at the Technical University of Madrid. A total of 198 students participated, organized into 33 work teams, with an average of 6 people per team.

The training method for acquiring teamwork competence is based on the Adaptive Flipped Classroom innovation method [22] The students have access to videos created by

the instructors, where each phase of the Tuckman method is explained [19]. Additionally, a wide variety of learning resources (web pages, images, texts, videos, etc.) produced by teams from previous courses are provided. These resources capture the experiences of the former teams during the completion of their work and their acquisition of different competencies. In this way, each team can select the resources that best meet their specific needs.

The instructors continuously and progressively monitor the evidence the teams and their members generate, producing a progress report for each team. This report is similar to a traffic light system: green - progressing adequately, orange - progressing but with errors, and red - not progressing adequately. The evidence generated by each team and the progress report from the instructors is analyzed in face-to-face sessions involving all students (all members of the different teams).

## 4 Results

The final objective of this section is to identify the capabilities and types obtained in this research, as well as the evidence that allows for their monitoring and assessment.

Section 4.1. Includes the evidence from which group skills are obtained. Section 4.2. Includes the evidence from which individual capabilities are obtained, both those specific to teamwork and soft skills.

### 4.1 Group Evidence

The group evidence is obtained from applying the team-focused model and demonstrates that the team has been able to overcome each phase of Tuckman's model.

- *Evidence indicating that the team has completed the Forming phase:* The team is formed, and the person who will act as coordinator is chosen. Leadership is shared, so there is no single leader but rather a general coordinator.
- *Evidence indicating that the team has completed the Storming phase:* Responsibility map. A table with tasks assigned to each team member. These tasks are of three types: management of the necessary technologies to acquire teamwork competency, tasks leading to the final work result, and leadership tasks.
- *Evidence that the team has completed the Norming phase:* Norms Document. A document agreed upon by the team members outlining the team's rules, conflict resolution, actions in case of rule violations, internal and external communication, etc.
- *Evidence of the team's progress:* Progress table. A document consisting of an individual work diary, where each team member records their work within the team (based on the responsibility map) and weekly reports on the work done by the team. This document helps the team track their progress and individual commitments, and it helps the instructors monitor and analyze the team's performance.
- *Evidence of the Delivering phase:* Deliverables. In addition to being used to assess the final result, the deliverables show the team's commitment to other teams and the course itself. Lessons learned aim to share the team's experiences in acquiring competencies with other teams, and temporary documentation includes the resources that have been helpful to the team.

## 4.2 Evidence for Assessing Individual Capabilities

The individual capabilities correspond to both teamwork-specific skills (identified in the IPMA model) and soft skills. The various sources used are:

- *Records of conversations between team members:* These conversations take place (privately for each team) in a Moodle forum, for example (though any social network could be used). A Moodle forum (an open-source learning platform) is used in this case.
- *Personal work diaries:* These are conducted in a specific forum thread and are accessible only to the team members.
- Documents generated as evidence in the previous stages: Responsibility map and progress tracking.
- *Organization of conclusions and evidence in Tuckman's model:* This is where the progress and conclusions of each phase are described. In this case, a Moodle wiki is used.

From this evidence, both the individual capabilities defined in the IPMA model and soft skills are obtained.

### **Evidence that Supports the Acquisition of Individual Capabilities From the IPMA Model**

- *Cooperation and Networking:* All internal and external team communication is done through online technologies. Cooperation is reflected through interactions between team members and the technologies used.
- *Empowerment of the team to define tasks and responsibilities:* The shared and authentic leadership method requires distributing coordination and monitoring tasks. These tasks are reflected in the responsibility map. The formative evaluation by the instructors ensures that these responsibilities are met, helping the students to carry them out.
- *Recognition of opportunities and continuous improvement:* The formative evaluation process, where students can periodically review the work done by other teams, allows for the incorporation of improvements. The lessons learned from previous years' teams also help improve the current projects.
- *Learning from mistakes:* Teams can learn from their mistakes as identified by the instructors, allowing them to correct these during formative evaluations.

### **Evidence from Which General Individual Capabilities (Soft Skills) are Obtained**

All of these are obtained from the analysis of conversations, where commitment, responsibility, empathy, willingness to collaborate, and critical thinking can be observed. They are identified using Generative Artificial Intelligence (GenAI) [23], which is applied to conversations. The system evaluates the soft skills based on the messages in the conversations, associating them with each team member and justifying them.

### 4.3 Summary of Evidence and Group and Individual Capabilities

Table 1 shows in the first column the type of source considered for detecting the capabilities: documents (usually tables summarizing the final result of a phase), the wiki (where final results of each phase and information from team members are organized), forums (where conversations between team members are structured in threads), and the training model. The second column contains the evidence created by the teams and their members that allows for the identification and evaluation of the mentioned capabilities. The third column includes the group and individual capabilities (both teamwork-specific and soft skills).

**Table 1.** Evidence and Capabilities

Type of Source	Evidence	Capability Indicator
Documents	Team members and coordinator Responsibility map Norms document Progress tracking table Deliverables	<b>Group capabilities:</b> Team formation Overcoming the Storming phase Overcoming the Norming phase Overcoming the Performing phase Commitment to other teams and the course
Wiki	Content organization Homogeneous format Access to the different sections of the work	<b>Group capabilities:</b> Ability to organize and manage content under a common vision
Forums	Conversations Work diary	<b>Soft skills:</b> Commitment, responsibility, cooperation, compliance, interest, cooperation with other members (self-help and mutual aid), empathy, critical thinking
Training model	Use of ICT for communication Online resources available to acquire competencies Face-to-face sessions with all students Continuous evidence tracking Formative evaluation based on continuous evidence tracking	<b>Individual teamwork capabilities:</b> Networking, taking advantage of opportunities, and empowerment Learning from mistakes and continuous improvement Tracking the work of both individuals and the team

## 5 Conclusions

When a single teamwork model is applied, training in certain capabilities is often not carried out. If a team-focused model is used, the final result of the work may be correct and even outstanding, but the involvement of team members may be unequal, with some

possibly evading their responsibilities. This is one of the main reasons why traditional teamwork models are not accepted by students who are responsible for their tasks. Therefore, it is necessary to have a model that integrates and analyzes both group capability (team achievement) and individual capability (the involvement of each team member in achieving the group's capability).

This hybrid model allows for the identification and detection of errors in the acquisition of different capabilities and in the real-time involvement of each team member. This feature promotes the homogeneous involvement of each member concerning the rest of the team. The development of teamwork is monitored in real time by both students and instructors. This allows for the immediate detection of each team member's competency acquisition, enabling formative evaluation and decisions that can correct possible deficiencies. The periodic and face-to-face sharing of progress has proven to be an effective tool for continuously improving teamwork evolution, as it promotes knowledge exchange among different teams.

This model also incorporates agile methodologies and Education 4.0, which involves handling technologies, learning from mistakes, delegating responsibilities, monitoring work, and making decisions. The training method for teamwork competence included in the model is key to acquiring the competencies associated with individuals.

For future work, the goal is to identify the specific indicators associated with each competency by creating an evaluation rubric and a technological and methodological framework for the hybrid model.

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