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A STUDENT TEAM BASED TEACHING APPROACH: THE TEAM S55 EXPERIENCE

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Abstract

In this paper the experience of a group of young engineers and students in aerospace engineering at the Politecnico di Torino has been presented. It has been shown how they forming a working group for the reconstruction of a flying model of the S55 seaplane designed and produced in Italy, beginning in 1924. The TeamS55, founded at the end of 2016,currently consists of about a hundred people who are able to cover all the phases of the aerospace production flow, from the conceptual design to the ground and flying test activities. The TeamS55 can be considered as a replica of a current aerospace company where all the roles and functions are adequately represented.

Keywords: Student Team, Seaplane, Teamwork, Psychodynamics, Education and Skill Development

1. Introduction

Many of the most prestigious technical universities are introducing a teaching methodology based on the student team approach. The strength of this teaching methodology lies mainly in the possibility to have continuous dealing with others students. It is than an opportunity for an exchange of ideas between the participants, and a means of gaining exposure for young designers, who are often the prime motor of innovation. Even if it seems that the educational aspects are prevailing, some elements dominate the scene and can significantly determine the success or the failure of the learning process. First of all, in the initial phases of the team organization it cannot be ignored the fact that it must be dealing with a dynamic system, with institutional policies and procedures, not always completely accepted by the team which is more oriented towards achieving the objectives, but essential in order to maintain the adequate level of safety during students activities. The assignment of tasks, objectives and verifications is another aspect in which arise the importance of consensus building and developing ownership in members by letting them be part of the decision-making process with full awareness of the consequences of their choices. The continual interaction among students and between teachers/consultant is also typical and representative of the complex dynamic among the team components of today's world of work.

Purpose of this paper is to present the positive experience, still in progress, of a group of young engineers and students in aerospace engineering at the Politecnico di Torino.

2. The S55 Aircraft

The Savoia-Marchetti S.55 was a double-hulled flying seaplane designed and produced in Italy, beginning in 1924. The S.55 featured many innovative design features and shortly after his entry into service, it began setting records for speed, payload, altitude and range.

All the passengers or cargo were placed in the twin hulls, but the pilot and crew captained the plane from a cockpit in the thicker section of the wing, between the two hulls as shown in Figure 1.

The S.55 had two contra-rotating propellers, mounted in tandem.

The engines were canted sharply at an upward angle. Two booms connected the triple-finned tail structure to the twin hulls and wing. Furthermore four steel cables are connecting the empennages group to the hulls and wing primary structure in order to prevent lateral empennages group movements. Hereinafter are presented some technical data related to: S55 variants, main characteristic, performance , civil/military operators. In addition for each variant is shown the number of built aircrafts the installed engines, the producer and some others details. It is an S55 Aircraft Catalogue, like the "Catalogue of Ships" as per Ref [1].

The aircraft was produced in many variants and the main ones are described in Table 1:

Table 1 – S55 Aircraft Variants

Variants	Description
S55	Prototypes and original production model delivered from 1927 to 1930, 90 built, including two prototypes.
S.55C	Civil variant delivered from 1925 to 1926, eight built
S.55P	Improved civil variant with enlarged hull for 10 passengers and enclosed cockpits delivered from 1928 to 1932, 23 built.
S.55A	Military variant delivered with 418 kW (560 hp) Fiat A.22R engines, 16 built.
S.55M	Variant (redesign by Giuseppe Gabrielli) with wood structures replaced by metal), seven built by Piaggio in 1930.
S.55 Scafo Allargato	Widened and deepened hull and enclosed cockpits, 16 built by Savoia-Marchetti and 16 built by CANT.
S.55 Scafo Allargatissimo	Variant with greatly enlarged hull, 20 built by Savoia-Marchetti, 16 built by Macchi and six built by CANT
S.55X	Variant fitted with Isotta-Fraschini Asso 750 engines for North Atlantic formation flights, later armed and used as a reconnaissance-bomber. 25 built.

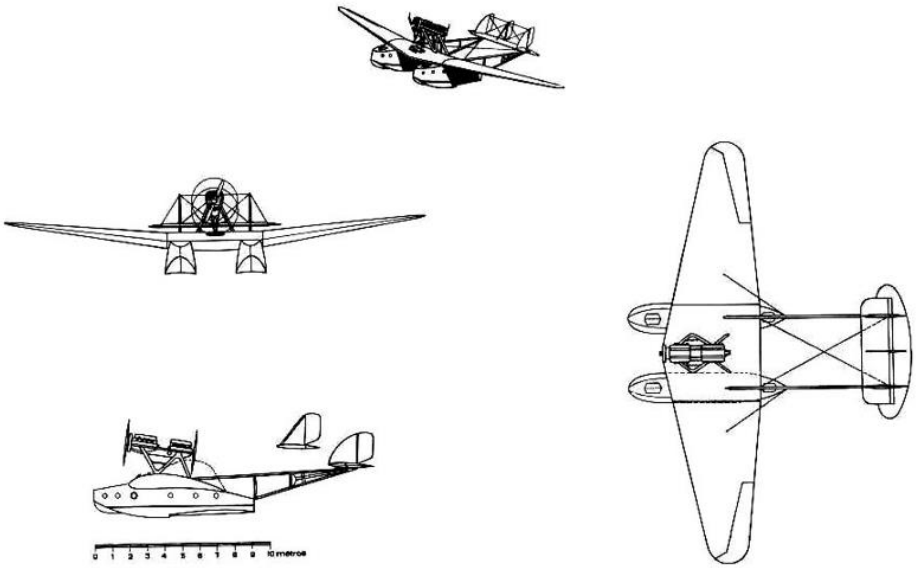

Figure 1 – S55 views – [2]

Table 2 shows the main geometric and performance characteristics while Table 3 identifies the main operators in the civil and military fields.

Table 2: S55 Main Characteristics [2]

Crew	2 pilots, 3-4 other crew members
Length	16.5 m (54 ft 2 in)
Wingspan	24 m (78 ft 9 in)
Height	5 m (16 ft 5 in)
Wing area	92 m^2 (990 sq ft)
Empty weight	5,750 kg (12,677 lb)
Max takeoff weight	8,260 kg (18,210 lb)
Powerplant	many power plant installation were designed a typical and well diffused one was with 2 × Isotta Fraschini Asso 500 V-12 water-cooled piston engines, 370 kW (500 hp) each mounted in tandem
Propellers	2-bladed fixed pitch tractor and pusher propellers
Maximum speed	205 km/h (111 kn)
Stall speed	105 km/h (57 knots)
Range	1,200 km (650 nautical miles) to 2,200 km (1,200 nautical miles)
Time to altitude	1,000 m (3,300 ft) in 9 minutes; 2,000 m (6,600 ft) in 25 minutes; 3,000 m (9,800 ft) in 45 minutes

Table 3: S55 main operators [2]

Country	*Main Civil Operators*
Kingdom of Italy	Aero Espresso Italiana
	Società Aerea Mediterranea
Soviet Union	Aeroflot
United States	Aero Transport Company d.b.a. AirVia.
	Marine Air Transport Co.
	Alaska Airways
Country	*Main Military Operators*
Italy	Regia Aeronautica
Brazil	Brazilian Navy
Spain	Spanish Air Force
Romania	Royal Romanian Air Force

Among the several versions available of the S55 for civil and military use the one (distinguished by the X) made to celebrate the tenth anniversary of the foundation of the “Arma Aeronautica”was the more significant. In the 1933 the “Decennale” air cruise was organized: under Air Minister General Balbo’s leadership, twenty-four S-55X (and an auxiliary one) flew from Orbetello, Italy to Chicago, across the Atlantic Ocean, to attend the "Century of Progress" Exposition. The fleet “covered 6100 miles in a flying time of 47 hours and 52 minutes”, with only one accident occurred. Representative John P. McSwain, Chairman of the House Military Affairs Committee said about this feat: "No 'round-the-world trip of any war-ship or fleet has ever impressed the people of the whole world as this spectacular flight of 24 planes.

3. POLITO Team S55

The TeamS55 was founded at the end of 2016 by a group of young engineers and students of “Politecnico di Torino” with the purpose to design and to build a 1:8 scaled flying “Replica” of the SIAI-Marchetti S55X designed by Alessandro Marchetti in 1923 [3-8]. Nowadays the team consists of about a hundred people who are able to cover all the phases of the aerospace production flow, from the conceptual design to the ground and flying test activities. The continuous increase in the number of participants required a preparation of an internal “rulebook team” that defines the team's structure, organization, goals and participants relationship. Furthermore, the Politecnico di Torino, in order to encourage the team organization, is providing for workspaces and economic resources. The TeamS55 can be considered as a replica of a current aerospace company where all the roles and functions are adequately represented. As a consequence, the TeamS55 itself can be considered as an industrial organization model whose purpose is to replicate a flying model. Its performance can be measured and, when necessary, adequate corrective action can be modulated in order to facilitate the goal achievement. The S55 Team is composed of various Sections with sections leaders that carry out the various activities, and respond to a Team Leader who coordinates them functionally. A reference professor and a technical consultant act as external supervisors in order to ensure coherence of the activities both from a technical and administrative point of view

The Team Leader, make use of transversal figures “Program Managers PM” who are responsible for the activities related to the specific program. One Section deals with all the activities related to the section as theoretical analysis, tests, construction, research, investigations at all required levels, preparation of reports, publications and everything else not detailed here which serves to achieve the objectives assigned to the Section. Figure 2 shows the trend of all the human resources involved in the team activities from its inception up to nowadays and the current team organization.

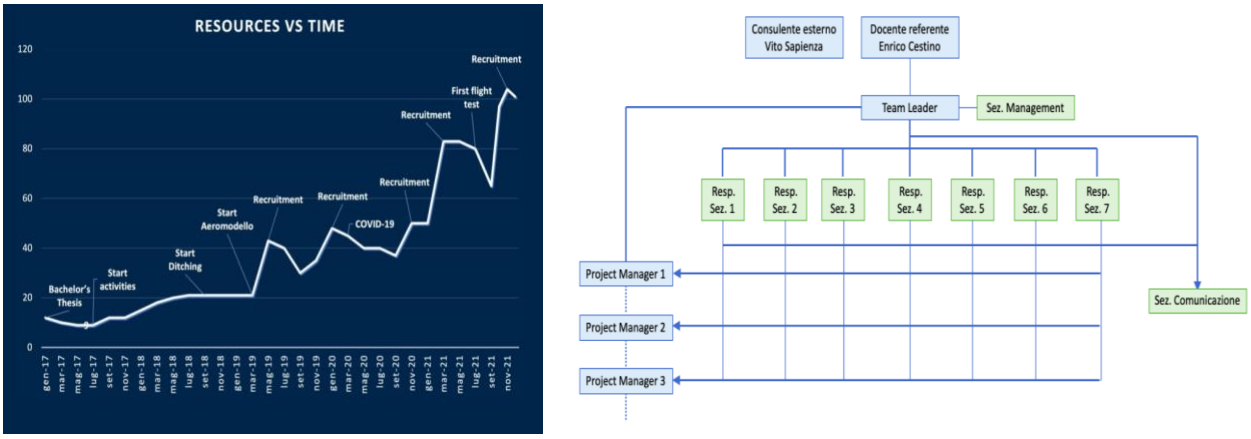

Figure 2 – Team Resources vs time and internal structure.

The team's first goal is to design and build a 1: 8 scale replica of the S55X with electric propulsion.

Starting from the drawings of the full-scale model, it was made the CAD model, compatible with the new ones dimensions (3m wingspan), preserving the main features and external shape of the original aircraft. The design choices were guided by the search for the minimum weight with a maximum weight target of the structure of 15 kg without batteries. This has led to the adoption of modern materials, carbon fiber composites and the use of innovative technologies including additive manufacturing. The S55 electric model has been entirely designed, manufactured and tested by the student team. A laboratory test campaign to verify the structural behavior, buoyancy and performance of the propulsion system was conducted in the laboratory, before the first flight test Figure 3. Around the main objectives, a series of parallel research activities are carried out by the different team sections in the fields of flight mechanics, aerodynamics, fluid structure interaction and materials technology.

The first prototype will be the basis for the second project of the Team called “S55-HERA” (S55 “High Efficiency Replica model Aircraft ") mainly devoted to the design and construction of a long range S55 scaled prototype based on a hydrogen Fuel-Cell system.

Figure 3 – S55X 1:8 scale Replica

The team's challenge will be to build the first hydrogen unmanned seaplane of the world and try to fly for a range comparable to that of the Atlantic crossings performed by the original SIAI-Marchetti S55X. From a myth of the past, the Team will therefore find the reason to push forward the interest in the research of those technologies that will be the future of aeronautics

4. TEAMWORK Model

The didactic methodology of involving students in working group has the aim of encouraging the learning of technical contents (hard skills), through practical experience. In this way, students have the opportunity to experience the team working (team working = soft skill) and to improve the knowledge through comparison and sharing information.

The S55 team has a dynamic behavior: a frequent turnover is normal. The activities have expanded over time and above all the number of the team members has grown exponentially. It started with a 10 people and currently is about 100 students.

Due to the current size of the team, it has been envisaged the need to make a diagnosis concerning its health status, to verify if it continues to operate effectively and to find, if necessary, corrective actions.

In fact, the more the size of the group and the activities to be carried out increase, the more complexity to manage by the leaders increases.

Taking as a reference *The Life Cycle of Groups: Group Developmental Stage Theory* by Roy B. Lacoursiere [9], it can be assumed that the S55 team is, today, in phase 2 "Dissatisfaction/Storm" and requires a better definition of activities, roles and rules (Resolution phase) before to approach phase 4 "Perform/Production " as shown in Figure 4.

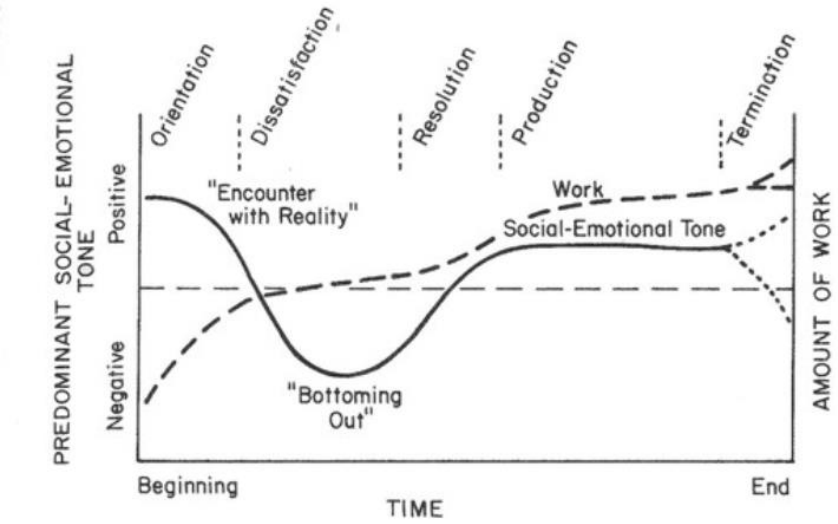

Figure 4 – Life Cycle of Groups [9]

To verify the above hypothesis and understand what corrective actions are useful to take, it was decided to proceed with an analysis of the team's status through a typical self-diagnosis tool adopted in a business context. The tool used consists of an online questionnaire based on a modified Blanchard's model [10] (TEAMWORK MODEL), validated through years of business consulting experience gained by authors.

The “TEAMWORK MODEL” is based on specific factors to be monitored by the working group to be effective. The present model is based on the following seven factors as shown in table 4.

Table 4: TEAMWORK Model main parameters

T OP	Leadership, recognized, authoritative and effective guide, efficient decision-making processes
E MPOWEREMENT	Trust, respect, mutual help, support, learning and growth opportunities
A DAPTABILITY	Flexibility, ability to adapt to changes, openness to different ideas, ability to find common solutions
M ORAL	Climate, sense of belonging to the group, cohesion and team spirit, motivation
W	
O RGANIZATION	Defined, communicated and realistic objectives, clear and shared roles and methods
R ECOGNITION	Positive feedback, praise, enhancement of contributions
K COMMUNICATION	Circulation of information. Clear, transparent and structured communication

The team member answers four significant questions for each of the selected indicators on a 5-level Likert scale where 1 means *strongly disagree* and 5 means *strongly agree*.

4.1 TEAMWORK Model Results

The questionnaire was provided to 96 members and was filled in by 77 people of which 35 have been in the team for more than a year and 42 for less than a year.

Figure 5 presents the results of the 7 parameters in graphical form and the comments for each of them are summarized below:

TOP: leadership emerges, to date, weak, that is, there is no clarity for everyone about who has the role of guide, responsibility and above all who should decide. This is often one of the main causes of conflict within a group. Students who have been part of the team for “more than a year” are more dissatisfied than younger ones.

EMPOWERMENT: The majority of the students highlighted the didactic value of participating in the S55 team and the possibility of learning and growing. However, it highlights the lack of organizational practices to support the goal achievement. The learning opportunity seems to be linked more to the work itself than the working team experience. One area of intervention must be that of "team building" or "rebuilding".

ADAPTABILITY: Team members claim to have good adaptability to change, but the team has internal rigidities that make it not always easy to negotiate to find common solutions. The ability to adapt is greater in the "new entries": curiosity for the new and the unknown can make more open and available. Overall, this turns out to be one of the team's most positive factors.

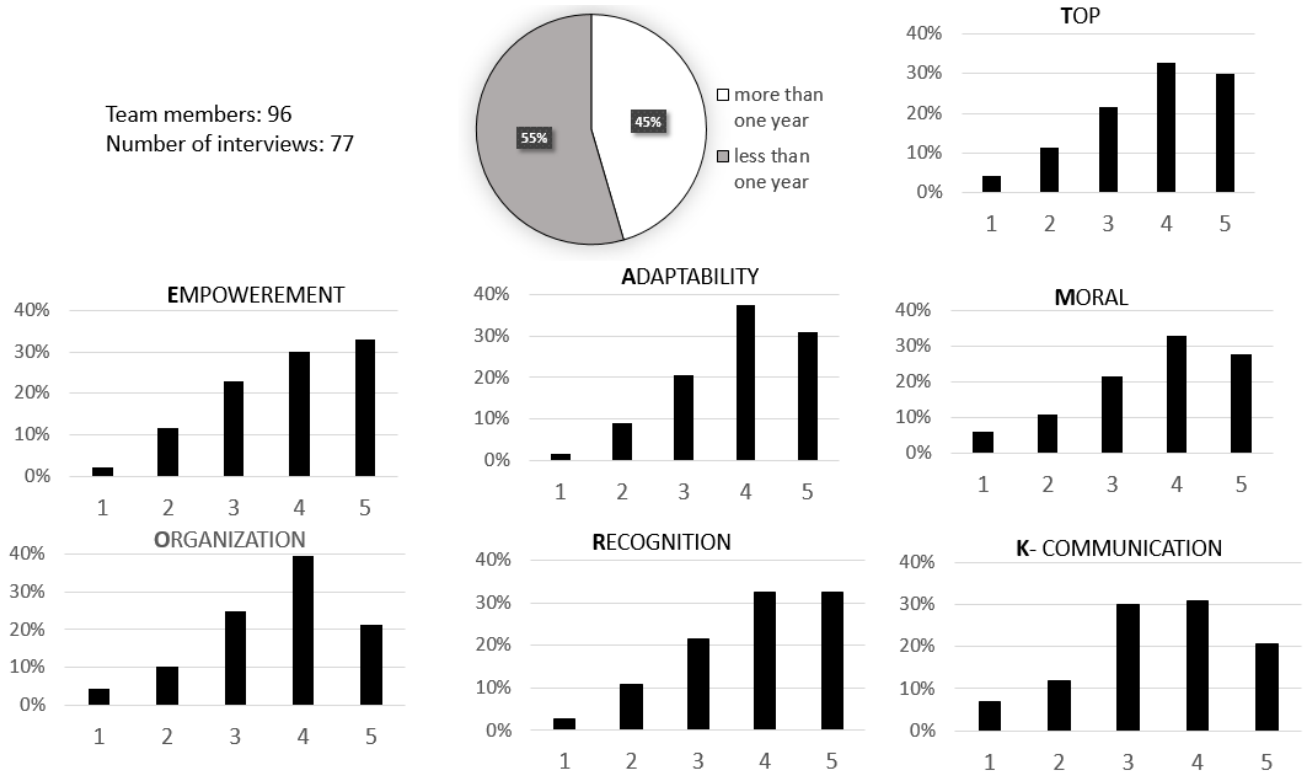

Figure 5. TEAMWORK Model Results

MORAL: This parameter is the most critical of the seven factors. The difference between junior and senior students is evident. The former are still motivated by the new experience, the latter have probably lost their motivation. The atmosphere and team spirit are elements that need to be worked on. Motivation cannot be left to individual choice alone, but must be managed by leaders.

ORGANIZATION: The interviewees perceive the presence of a team and work organization, in terms of defining objectives and roles, but believe it can be improved

COMMUNICATION: This factor is one of the most critical. Only half of interviewees think that the

team's communication tools, such as e-mails, meetings, reports are well structured and effective.

"Junior" students have a more positive perception of communication than "senior" students.

RECOGNITION: Even if the successes are sufficiently celebrated, half of the interviewees show a lack of recognition by the organization. In general, this factor, together with Adaptability, is one of the less critical of the team.

5. Psychodynamics in a specialized working group

A very specialized working group continuously fluctuates between investment/excitement and divestment/impotence. This psychodynamics is felt when the remaining, time devoted to design activities, appears to be limited or when there is no agreement on a design detail. As a matter of fact the idea of wasting time is based on the idea of not making it in time to reach the goal [11].

The clear purpose of a specialized working group is to achieve the defined goal.

The more complex the objective appears, although real, the more the team gets excited in defining the procedures. All work together as one.

The hidden purpose of a working group is to protect the survival of the group itself. However, the achievement of goals sets the death of the group. The more the group works well, realizing significant libidic/affective bonds, the more the conflict rises.

This antinomy is inherent in every specialized working group. Every time the group breathes you may have a feeling not only unique but unrepeatable; it is the breath of a monster. Fleeting and various thoughts lodge between evident and hidden purpose, like buzzing flies around a bucket of freshly milked milk [12]. The panicking idea is that once the goal has been reached, the work and therefore the group cease to exist.

Photos, sparkling wine and eat all together, give a sense of pleasure whenever the intermediate goals are reached nevertheless, at the same time, the painful ritual of the grieving process begins.

Everything is comparable to the state of mild sadness at the end of each holiday. In this hiatus the group wears out its brief existence. Hallucinate a survival by inventing and raving processes of immortality.

This is the real reason why the operative groups get jammed beyond the excellent skills of the individual components. One then unconsciously looks for a debacle, a stumbling block, to accelerate the rhythm of work so as not to think unthinkable thoughts, id est, beta thoughts.

Happens a fight with the time in the same way as between two lovers is always present a third one, Kronos.

Moreover, the team works on the topic, in this case the Savoia Marchetti seaplane, but in fact, being a simulacrum among other things hybrid, the team works on the team and therefore among its objectives has to take care of the activities organizational, at the same time cures himself through that function that psychoanalysis group, appoints *gamma function* [13]. In the same way that the terminally ill does not think about his death but about the welfare of his doctor for the infinite cure. In fact, it often happens that a member or a subgroup names a difficulty and then gets electrified to have identified the way out of the impasse.

The last consideration is the content of thie activity . Two topics:

- first: the seaplane is brought back to live, the event produces magical thoughts in the group. Symbolically, it is like returning the fetish to the parental couple (managers / coordinators) that fertilized the unconscious desire of the students. A job to produce a copy in absentia.
- The second fact, which can be considered peculiar, consists in creating not a clone but a re-reconstruction. The Marchetti becomes a chimera. It has the wings of the grouse, the cylinders of a Landini hothead [14], the cockpit of the Antonov's poor child, the propellers shaped from the genome of Hotzi [15]. As a matter of fact the parental couple (fecundating) is raped in groups by young people who at the same time, while working together, they mock and joke about the parental couple. The son, in mocking the father, elaborates his guilt: related to the father replacing in the leadership.

The words, the jokes, the laughter will become the mortar that, like ambrosia, will keep the memory of the group in the shadow of Savoia Marchetti seaplane in the future.

The working group in building an airplane gets excited as it makes a dream come true and the airplane becomes a dream driven by wakefulness. The work team experiences an intoxicating experience as it comes into contact with the mental symmetry that is implicit in flight. The SS Marchetti is the simulacrum of a real object and at the same time a fetish of itself.

At times, the team seems to experience, through the careful use of logical mathematical processes and algorithms, a magical and therefore intoxicating, mythical thought. The flight is fertilizing Gaea. An incestuous fantasy therefore exciting as it has to fight against the reality of gravitational force

6. Conclusions

This "working team" approach can be considered as a teaching methodology, the students have the opportunity to learn how to work in a team , achieving and sharing technical content between the colleagues having well in mind the target of their activity. Furthermore some psychodynamics aspect have been also evaluated in order to focus about the more complex relationship between the team components.

A detailed analysis has been performed with the purpose of investigating the main factor that are driving a working group. The “TEAMWORK MODEL” was the model used that permit to monitor the Team state of wellness. The main topic is that the leadership management is not clear, as also the decision chain needs to be improved, this is one of the main cause of dissatisfaction inside the team. The results show also the dissatisfaction is higher increases among older team members.

Furthermore the potentialities of the team potential capabilities have been also evaluated and it became clear that there is a great margin of improvement of the performances and of attainment of more and more challenging objectives

The start of activities on the design and construction of the new model with hydrogen propulsion is considered essential for future activities

7. Contact Author Email Address

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8. Copyright Statement

References

[1] The Catalogue of Ships (Ancient Greek: νεῶν κατάλογος) is an epic catalogue in Book 2 of Homer's Iliad (chapter 2, verses 494–759), which lists the contingents of the Achaean army that sailed to Troy.

[2] Jane's all the World's Aircraft 1928 by C. G. Grey

[3] Cestino E.; Frulla G.; Sapienza V.; Pinto P.; Rizzi, F.; Zaramella F.; Banfi D. (2018) Replica 55 Project: A Wood Seaplane In The Era Of Composite Materials, In: Proc of 31st ICAS 2018 Congress, 9-14 September 2018, Belo Horizonte (Brasil)

[4] Favalli F., Ferrara M., Patuelli C., Polla A., Scarso S., Tomasello D., REPLICA 55 PROJECT: AERODYNAMIC AND FEM ANALYSIS OF A WOODEN SEAPLANE. Proc of 31st ICAS 2018 Congress, 9-14 September 2018, Belo Horizonte (Brasil)

[5] Di Ianni L., Loiodice L., Celestini D., Tiberti D., Baldon C., Iavecchia P., Saponaro Piacente A., Prodan M., Grendene S., Barberis B. & Santoro L., TEAM S55: 1:8 SCALE “REPLICA” OF THE SIAI-MARCHETTI S55X, Proc. 32nd ICAS Congress 6-10 September 2021 - Shanghai, China

[6] Iavecchia P.;Campolo G.; Maritano G.; Coppola M., Cestino E.; Frulla G.; Sapienza V. & Piana P. Application of Additive Manufacturing to the production of RPAV components. Proc. 32nd ICAS Congress 6-10 September 2021 - Shanghai, China

[7] Baldon C.; Indelicato R.; Bottino N.; Sinisi M.;, Carrone F., Cantanna G.; Cestino E. Sapienza V. S55 Project - CFD analysis of an historical seaplane. Proc. 32nd ICAS Congress 6-10 September 2021 - Shanghai, China

[8] Nicolosi G., Valpiani F., Grilli G., Saponaro Piacente A., Di Ianni L., Cestino E., Sapienza V., Polla A., PIANA P. Design Of A Vertical Ditching Test. Proc. 32nd ICAS Congress 6-10 September 2021 - Shanghai, China

[9] Roy B. Lacoursiere: The Life Circle of Groups: Group Developmental Stage Theory, New York: Human Service Press, 1990

[10]Kenneth H. Blanchard, Donald Carew, Eunice Parisi Carew COSTRUIRE GRUPPI DI SUCCESSO F. Angeli Ed., 2002

[11]Sapienza S., Tenerini A. (2018) FREUD, BION, MATTE BLANCO, CORRAO E L'ARCO DI FILOTTETE -Mito, clinica e ricerca in psicoanalisi- Roma, Armando Editore

[12] Homer Iliad chap. XVI (640, 644)

[13] Journal of Group Psychology https://www.funzionegamma.it/

[14]https://it.wikipedia.org/wiki/Super_Landini

[15]www.nature.com