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Network assessment: Design of a framework and indicators for monitoring and self-assessment of a customized gender equality plan in the Mediterranean Engineering Education context

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ABSTRACT

With more than 28 active members, the Mediterranean Engineering Schools Network (RMEI) is the most active network on gender equality in the Mediterranean area. Supported by the HORIZON2020 TARGET project 'Taking a Reflexive Approach to Gender Equality for Institutional Transformation', in conceptualizing gender equality learning and system change, the network took a context-specific approach based on a theory of change and other STEM organizational frameworks, to design a self-assessment framework and indicators, considering the systemic view of SDG5 horizontally connected to all SDGs, national context complexity, and transdisciplinary requirements. 95 simple, practical, user-friendly indicators were designed, fitting in the specificities of the Mediterranean-Engineering context. The analysis showed that the network realized its vision, made the 'passage' from theory to praxis on gender equality change, effectively developed meaningful processes/structures, formulated a policy statement, built a community of practice and inspired members. It also achieved trustful relationships and inspired outputs, effective communication, sharing of information and resources, and top management commitment. Critical aspects are a) the analysis in depth of issues linked to the existence of gender-based stereotypes and bias in engineering schools of the Mediterranean that entails tackling gender ideologies considering the whole national social system and existing structures; b) sustainability of gender equality structures created at the member institutions with the support of TARGET project which is depending on the willingness of each institution's leaders to continue/advance with gender-sensitive strategies in their institution.

1. Introduction

Gender equality (GE) has been acknowledged as important objective for sustainable development, aiming to a fair and equal society, reflected in the SDG5 of the United Nations (UN) (UN Women, 2019). Although there is a need for Higher Education Institutions (HEI) to support gender equality towards achieving an inclusive education, yet this remains a wicked problem, witnessed by the persistent under-representation of women in senior positions (Loots & Walker, 2016).

Despite the over half of all PhDs being awarded to women, the percentage of female tenured faculty members are between 20 % and 33 % in the EU, and falls to 5% in Engineering fields (EIGE, 2016). Engineering Education Institutions are gendered settings, often due to the societies' tendency to associate engineering and technology with men. Top hierarchical positions, senior management, and leadership posts are more frequently occupied by men (vertical segregation), while unconscious, and/or conscious bias exist, rooted in personal patterns and culture. Institutional change needs a strategy to remove the obstacles to gender equality and adapt practices, monitoring and assessment of plans (EIGE, 2016).

Monitoring and assessment of gender equality plans (GEPs) remain limited or poorly utilized, making it difficult to know if efforts and commitments towards gender equality goals are on track (Demetriades, 2019; Moser, 2007). Measuring gender equality is not a practical exercise, but the result of increased institutional willingness, and capacity to identify and address gender bias and monitor progress in a sustained way (Wroblewski, 2015). Monitoring is a systematic collection of data (starting with the audit of priorities, results, goals, and targets) while

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evaluation is the systematic and objective assessment of a program, plan, and policy (Espinosa, 2013).

Evaluation is 'the systematic collection of information about the activities, characteristics, and outcomes of projects' (Rossi, Lipsey, & Freeman, 2004) aiming to determine the accomplishment of the objectives, the efficiency, effectiveness, impact, and sustainability of a plan. It can help decision making to ameliorate institutional operation (Wroblewski, 2019), assess impacts on various topics, help in understanding the functionality of the system, boost management processes transformation (Espinosa, 2013).

Evaluation entails a variety of conceptual, methodological, and operational challenges (Brisolara et al., 2014). Developing a conceptual evaluation framework is an exercise that involves searching in literature studies, consultations with experts, policy makers, practitioners, and other related stakeholders. Evaluation done well can be transformational (Montrosse-Moorhead, Bitar, Arévalo, & Rishko-Porcescu, 2019), but rigorous impact evaluation cannot address complex systems (Uitto et al., 2019).

Although, monitoring and self-assessment of a gender equality progress are key aspects of a sustained, reflexive, and participatory process, evaluation remains limited because gender equality is a complex endeavor, having interactions with other social aspects and all SDGs. Therefore, in the evaluation of gender quality actions, intersectionality, context, and synergies should be given importance (Fazey et al., 2019). When evaluating gender equality interventions, it is important to define gender-sensitive criteria and to ensure the participation of all stakeholders in the process (participatory process), paying attention to the circularity of the process (Kalpazidou Schmidt & Graversen, 2020), and contextualizing theoretical and the practical applications (Brisolara et al., 2014).

Innovative approaches include efforts to incorporate a broader set of evaluation indicators into the Millennium Development Goal3 (MDG3) on gender equality and review the United Nations Development Programme (UNDP), (UN Women, 2019). Other important developments include the adaptation of international indicators to better represent gender equality in region-specific contexts or to harmonize gender indicators according to the Bridge report (Demetriades, 2019). Recently, in the frame of the HORIZON2020 EFFORTI project (Evaluation Framework for Promoting Gender Equality in Research and Innovation), a conceptual evaluation framework with sophisticated and practical instruments was developed to evaluate the impact of gender equality interventions in R&I (Kalpazidou Schmidt & Graversen, 2020). This framework embraces the complexity of dynamic contexts and adopts a holistic view (Palmén et al., 2019).

1.1. Scope and objectives of the study, innovative aspects

All the above call for initiatives aiming at measuring institutional and cultural change, by using gender-responsive and gender-sensitive strategies and evaluation, employing quantitative and qualitative data. In Engineering Schools, there is a great need for initiatives aiming at institutional/structural and informal/cultural change, along with gender-sensitive measurements that are critical for enabling better action planning and holding institutions accountable to their commitments to gender equality.

This work aims to present a context-specific and region-specific case study based-work on gender equality monitoring and self-assessment by presenting how interventions directed by the Mediterranean Network of Engineering Schools (RMEI) integrated the gender dimension at the network's organizational level, and at the level of member-institutions. Taking in account the complexity of gender-sensitive and theory-based evaluation approaches, and that gender equality interventions address complex systems, the effort was to design simple, practical, user-friendly indicators, considering regional, national, and organizational contexts and the empirically of the interventions.

The study also addresses the question of how a network can take a systematic process to approach the linkages between implementation plan in gender equality interventions in engineering institutions, accounting for context sensitivity and methodological pluralism. This action research is a collaborative production of scientifically and socially relevant knowledge through a participatory process (interdisciplinary approach).

Finally, this article aims to outline the foundations of the dynamic network (RMEI) perspective on gender quality change and the gained new insights on the network's organizational change as a fundamental relational variable that has the potential to inspire members (as network-members work together). The findings of this study may be useful to academic leaders, and administrators of other higher education institutions on how to advance and monitor gender equality progress according to the specific institutional characteristics and regional cultures.

It is important to mention that the innovative aspect of this study is the interdisciplinarity that integrates knowledge from social studies and engineering. Usually, social change studies are the subject of social scientists because it is their domain of interventions, but in this study a network of engineering schools in Mediterranean takes the leap towards learning and acting for a systemic social change (gender equality), providing thus an alternative learning to the classical university's approaches.

2. Self -positioning

The interconnections of RMEI network with gender equality, the scientific and territorial contexts as they will be discussed in the following sections are schematically depicted in the representation of Fig. 1.

2.1. The RMEI network

The Mediterranean Network of Engineering Schools (RMEI) was created in June 1997 at the initiative of the Ecole Supérieure d' Ingénieurs Group of Marseille (ESIM) (http://www.rmei.info/index.php/en/). It is based on a strong set of common values of sustainable development (SD) among its members. From this common ground, different exchanges and links between different entities are created. These relations are based on trust, guided by the principle of norm reciprocity, and are animated by a common vision embodied by all members. The network is also affiliated to UNESCO UniTwin chair of Sustainable Development innovations. Its mission is SDGs accomplishment and Peace in the Mediterranean region, through education on sustainability, responsible research and innovation (RRI), and inclusivity (Vincent, 2009; Zabaniotou, 2020a, 2020b). Fig. 2 depicts the countries of the RMEI members.

The important characteristics of the RMEI that differentiate it from universities are:

a) The learning potential

The network fosters the share of skills and knowledge among students and faculty the members for environmental protection, renewable energies, sustainable use of resources, recycling, and water and in general SDGs innovations (Fig. 3).

b) The facilitation of multi-disciplinary synergies

The network facilitates multidisciplinary synergies, especially in research consortia of academic member-institutions and in SDGs innovations (Fig. 4).

c) The accountability towards commitments

The network ensures the accountability of members towards their

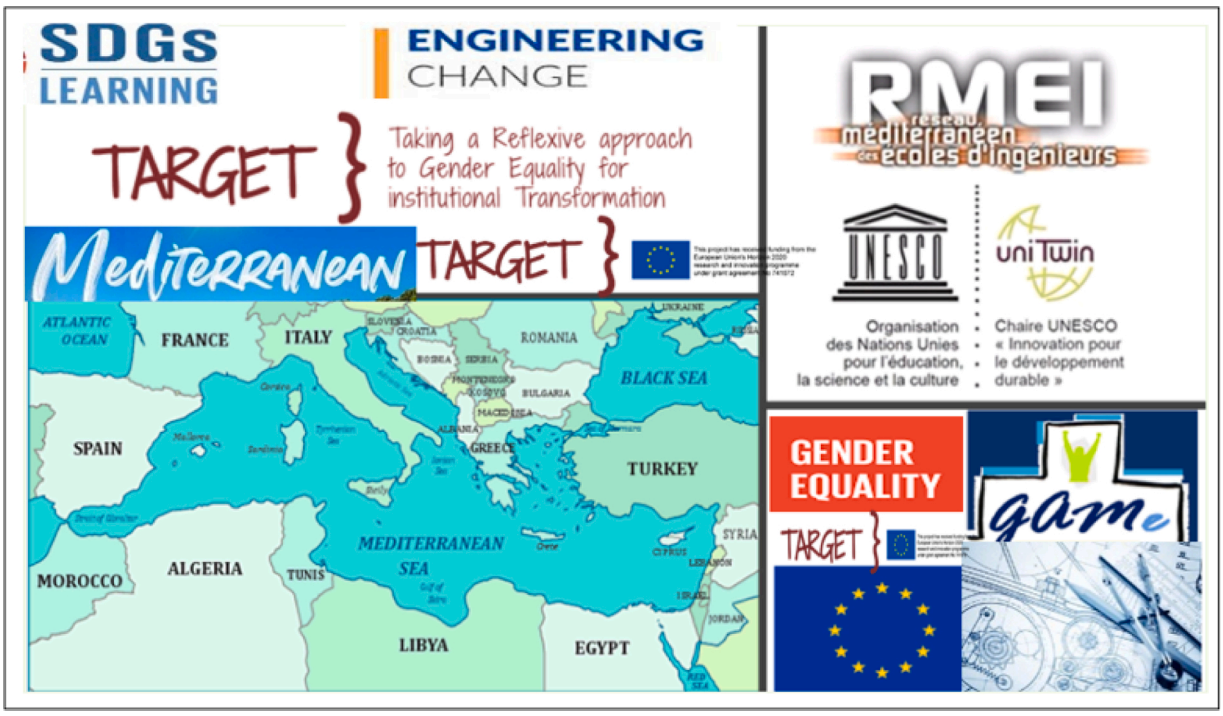

Fig. 1. RMEI, the engineering context in the Mediterranean territory and the interconnections with EU TARGET project through the gender equality principle.

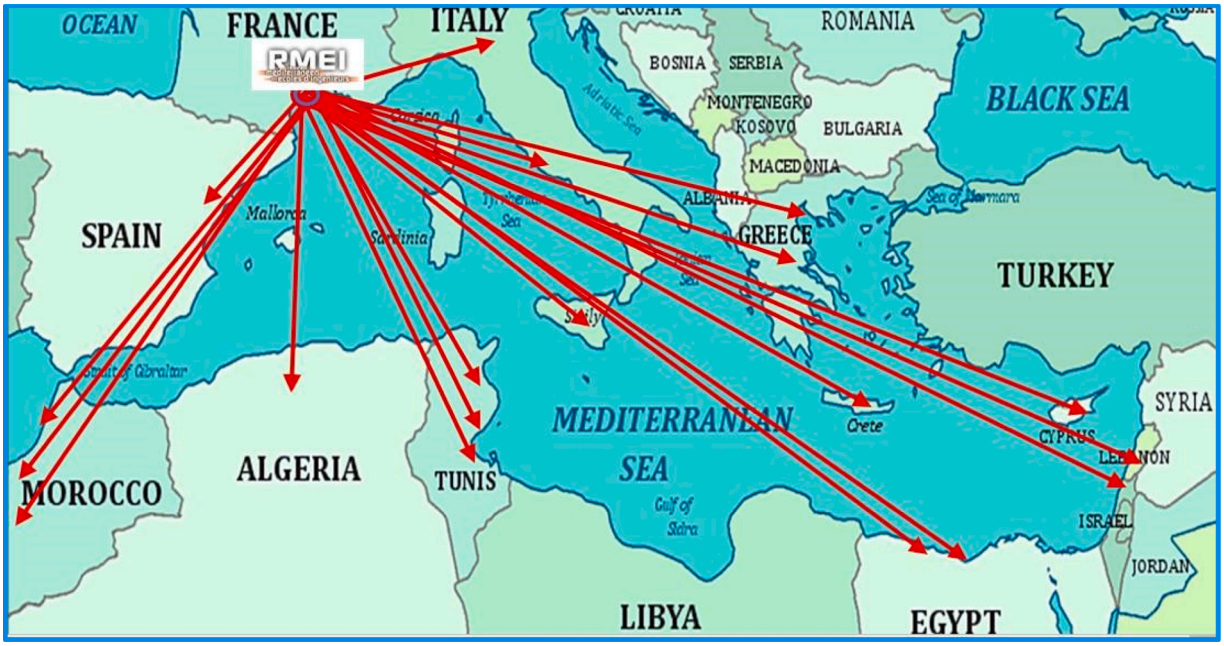

Fig. 2. Members-institutions (engineering schools) of the RMEI network are distributed in almost all Mediterranean countries.

commitments due to the sense of obligation and trust among members.

d) The broadening of actions

The network broadens the potential actions implemented by members.

e) Potential of change

The network's learning potential is combined with the Mediterranean common culture and vision that are key elements in defining its potential for change.

The RMEI network envisions to inspire the gender equality principle at member-institutions for a change that is long-term, but achievable. The long-term changes that the network is envisioning are depicted in Fig. 5.

The strengths, weaknesses, opportunities, and threats of RMEI network were elaborated in a SWOT analysis, prior the application of the gender equality process and strategy (Table 1).

Fig. 3. Collaborative learning and skills development for Sustainable Development innovations are the characteristic of RMEI.

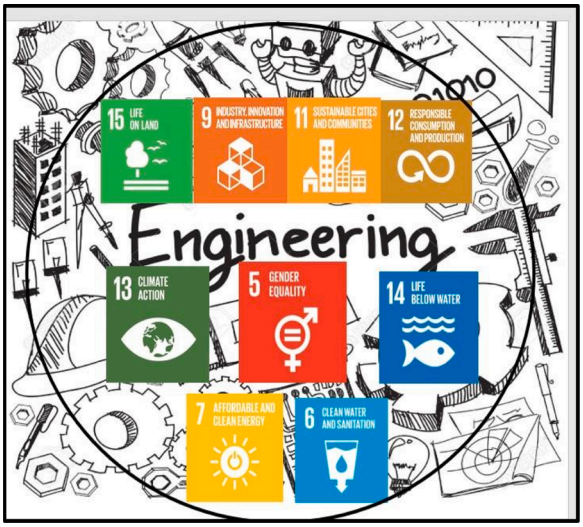

Fig. 4. Engineering education for SDGs is the mission of RMEI.

2.2. The TARGET evaluation framework

The evaluation methodology proposed by HORIZON2020 TARGET project 'Taking a Reflexive Approach to Gender Equality for Institutional Transformation', where RMEI is a partner, has guided the gender equality working group of RMEI in the process of change. TARGET that is a four-year project, started in 2017 and ends in 2021. TARGET's approach emphasizes a reflexive process (https://www.gendertarget.eu/).

TARGET's novel evaluation approach weaves together institutional self-assessment based on monitoring (facilitated by supporting partner) with an evaluation (conducted by a different partner). This approach assumes that successful and sustainable implementation of gender equality plans (GEPs) requires reflection of existing structures and practices regarding an inherent gender bias, development and implementation of alternative practices and assessment of gendered effects of such interventions. Thus, monitoring, and self-assessment provide the basis for the evaluation to avoid resistance, lip service or pro forma action that has in the past been associated with external evaluation.

This relationship between self-assessment and evaluation is key to the projects' sustainability and success. Self-assessment will enable the institution (in our case the RMEI network) to critically reflect on and successfully embed the gender equality policy and strategy within the institution/network throughout the implementation process. Final evaluation will be conducted by the coordinating partner who is not involved in supporting activities (Wroblewski, 2019).

3. The context of engineering education: looking beyond traditional gender lens

In this section we discuss engineering education-context characteristics, SDGs and other frameworks that are inherent in engineering education and practices for sustainability, inclusion, equality, in the 21st century.

3.1. SDGs framework

Within the 2030 Agenda for Sustainable Development, education is seen as the key for achieving not only SDG4 that stands for 'ensuring inclusive and equitable quality education and promote lifelong learning opportunities for all', but all the other SDGs, significantly contributing to gender equality, health and well-being, better economic and social status, and improved quality of living.

Gender lens approaches have expanded in recent years regarding implementing gendre equality in universities. New interest is seeking ways in aligning gender equality activities in support of the United Nations Sustainable Development Goals (SDGs). In Europe, there is call

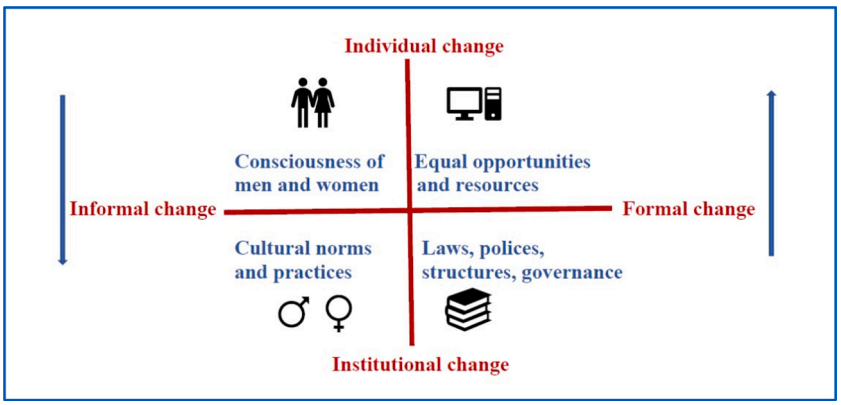

Fig. 5. Short-term and long-term changes that RMEI is envisioning on GE.

for action for all stakeholders (governments, organizations, universities, and individuals) to align their activities to support the 2030 Agenda. All 17 SDGs and many of targets and indicators point out the need for increased access to social, economic, and environmental systems, highlighting the interconnected nature of the goals. To cite some examples, strategies to achieve the goal of affordable, reliable, sustainable energy (SDG7), clean water, sanitation (SDG6), food security (SDG15), sustainable transportation, cities and communities (SDG11), inclusive and sustainability-oriented education (SDG4) etc., are intertwined with strategies that reduce gender inequality, and spur economic growth. Tackling climate change (SDG13) and working to preserve our ecosystems is interconnected with the gender equality empowerment of women (SDG5) and the redefining of gender differentiated vulnerabilities and inequalities (Zabaniotou, 2020a).

Engineers can play an important role in sustainable development by designing planning and building projects that preserve natural resources, are cost-efficient environmentally safe, and support human and natural environment (areas that map closely to the 17 UN Sustainable Development Goals). Engineers have a role to play bridging the gap between living in urban areas and those in rural areas, to find solutions for the shortage of resources, and equal opportunity for engagement regardless of geographic location, economic status or standard of living, and to contribute to designing a future that fits for humanity, by embracing ethics of an equitable world. Engineering should serve the needs of humanity, in terms of providing sustainably for present needs and of future generations, and equitability (Marjoram, 2019). A broad range of issues ranging from nature inspired design and resource efficient production to sustainable business and consumption models, as well as challenges in educating and communicating the underlying principles of sustainable development across a multitude of industries, processes, and products, are domains of engineering practice for sustainable development.

Although, sustainable development (SD) has had different interpretations over the years, there is a common agreement that it promotes prosperity and economic opportunity, social well-being, and protection of the environment. A greater understanding of sustainable development challenges through the SDGs framework has created an important increase of research in this field by the engineering community including in this context, several new perspectives (Rahimifard & Trollman, 2018).

The engineering definition of today could be: 'Engineering is the social practice of conceiving, designing, implementing, producing, and sustaining complex eco-socio-technological products, processes or systems' (Canbazoğlu, 2018).

3.2. Systems thinking framework

Systems thinking is the problem-solving framework for sustainability encouraging to explore inter-relationships (context and connections), perspectives (each actor has own unique perception of the situation) and boundaries (agreeing on scope, scale and what might constitute an improvement).

Systems thinking is particularly useful in addressing complex or wicked problems compared to 'reductionism' (looking at the parts), dualism (viewing things as separate), and myopia (taking a narrow view), that in the last few hundred years of the industrial revolution have increasingly developed the ancient anthropocentric way of relating (Seibert, 2018).

Recognizing that achieving meaningful change in engineering education requires changing the entire system, viewing social systems nested within natural systems (Williams, Philipp, Kennedy, & Whiteman, 2017).

3.3. Interdisciplinarity/Transdisciplinary frameworks

Interdisciplinary and multi-stakeholder research is increasingly being implemented to enhance understanding of global environment change, identify holistic policy solutions, and assist implementation of related actions. Towards an understanding of a change, global transitions require interdisciplinary and transdisciplinary thinking (Feulner, 2015). The complex nature of SDGs requires interdisciplinary/-transdisciplinary approaches, encouraging the engineering community to work closely with experts from other fields such as social science, humanities etc., that they may not have interacted with previously, and other stakeholders, overcoming the inherent barriers (Salvioni, Franzoni, & Cassano, 2017).

The traditionally disciplinary approaches are conducted mainly within the bounds of a single discipline that works with discipline-specific questions-hypotheses-theories-models-methods, while there is no significant linkage with other disciplines. With an inter-disciplinary approach, scientists in different disciplines may work together on the same issue, but each can work with her/his own methodologies that result in individual outputs (Matsuura & Razak, 2019). Then they may share the same methodologies and each other's findings, thus the disciplines become more integrated (Guimarães, Pohl, Bina, & Varanda, 2019).

Transdisciplinary approaches require different stakeholders of various disciplines to collaboratively find solutions beyond the limit of single disciplinary knowledge, and to work outside of own disciplinary, aiming to create sustainable solution-oriented knowledge for complex problems that cannot be solved by a single discipline and helping in taking eco-social sensitive decisions that are of paramount importnance (Zabaniotou et al., 2020).

However, learning about how to do gender equality change or any change is inhibited by the lack of conceptual development and appropriate methods to evaluate complex and multifaceted processes (Fazey

Table 1
SWOT analysis for RMEI.

	Strengths	**Weaknesses**
Internal	• RMEI is a network of engineering schools, opting for sustainability in education, research, and innovation. • It gathers a high number of engineering schools around a common vision. • It has high learning potential. • It bridges the Mediterranean countries and people through their common history, cultural heritage, and sea. • The network is dedicated to fully exploit its learning potential by gathering a Gender Equality Working Group (GEWG) composed of members coming from different Mediterranean countries and specialized in different scientific fields. • It has a strong culture of trust and knowledge sharing among members and the feeling of a community. • It recognizes that education in the Mediterranean needs transformation by introducing SDGs innovations. • It can play a key role in contributing to social transformation of member-institutions. • The network by gathering different entities together, around common values and vision, encourages member-organizations to challenge and question their informal norms on GE. • It can instantiate a gender equality discussion and share good practices. • It has created a sub-network of young students entitled GAMe (in Italian). • It connects science, engineering, and art at the annually organized MICHELANGELO workshop by GAMe (students' network)	• It has no power of decision on its member-institutions. • It lacks strong financial support because most of the Mediterranean countries are facing economic crises. • It keeps the membership-fees very low to allow Mediterranean institutions to participate, which creates a weak budget. • There is a geographical distance between the premises of the network and member-institutions, making the mobility costly. • It has members from various Mediterranean countries that face political conflicts, wars, economic crisis, social upheavals, immigration, etc. and therefore cannot effectively participate in the activities and programs of RMEI.
	Opportunities	**Threats**
External	• There is a rising-awareness on gender equality issues around the Mediterranean countries due to cultural revolution in many countries. • GE is currently being adopted by European countries; therefore, the plan is directly facilitated by EU political commitment. • Many related associations on women and energy, women and STEM, women, and environment etc., are already active in the Mediterranean countries. • There are many female students in Mediterranean engineering schools especially in Maghreb, Greece, Cyprus, and Middle East countries, sometimes reaching 60 % of the total students. • In the European Mediterranean countries, the law on gender equality is implementing, which creates the best practices for other countries.	• There is an important lack of available data on gender equality in Mediterranean engineering schools. • There is a lack of strong financial budgets in the institutions. • There is a political instability in many Mediterranean countries. • The Mediterranean is a hot-spot in climate change, environmental and social challenges. • Political and cultural contexts can hinder initiatives supported by the network. • Mediterranean countries are facing scientific brain-drain. This makes it harder for the Mediterranean university to consider gender equality as a priority topic. • Due to existing conflicts and instability of peace in some countries, the active participation in the network is decreasing.

et al., 2019).

3.4. Diversity and inclusion framework

The sustainability-oriented education and transformation at the higher educational level calls for equality and diversity in Universities. Universities should assume a privileged position as key drivers of education for the sustainable development, diversity, and equity (Salvioni et al., 2017).

In the context of engineering education, the term diversity signifies difference in terms of people, gender and the identity categories. The lack of diversity and gender equality signals a large absence of the potential for growth and innovation and leads to a countless number of missed opportunities. There is a need to disorve the barriers determined by socially constructed identity categories for shaping the future workforce through gender sensitve initiatives, capacity building through diversity and inclusiveness and culture change (Walker, 2017).

Both men and women engineers, managers and scientists can make substantial contributions to the sustainable development. Gender equality in Engineering Education can better prepare men and women to work on sustainable solutions and benefit entire societies.

3.5. Critical thinking in solving complex problems framework

The complex nature of global challenges requires wide-ranging skills, critical thinking, creativity, and knowledge-transfer between various social, life and physical sciences and engineering disciplines.

Engineering education seeks to enable the development of intellectual capacities of individuals by conscious, organized, and beneficial project-based activities. Solving a problem is a complex cognitive process, which begins with a subjective experience of difficulties of the context by an individual and ends up with a sense of satisfaction/joy because of a its successful outcome (Tyng, Amin, Saad, & Malik, 2017).

Since the solution of the problem requires the investing of mental effort, the role of problem-orientated learning is particularly reflected in the process of engineering education. The word "problem" derives from the Greek word 'πρόβλημα-provlima' and means a scientific task or a controversial question, used mainly to indicate an obstacle that the individual/system faces. To overcome the cognitive impediment, in solving the problem, an adequate cognitive effort is needed that is defined as the level of engagement to activities, the goal of which is to overcome the impediment. In the process of solving the problem, the acquired knowledge and previous experience are not enough, which creates the need for acquiring new knowledge (Orlović Lovren et al., 2019). Usually, the problem is characterized by a high level of complexity, that requires an active position as well as a research approach in the process of solving it and brings the development of critical thinking. Any solution of a complex problem necessarily includes critical thinking, and creativity in the realization (Orlović Lovren et al., 2019).

3.6. Leadership capacity

The openness of the leaders/professors to support creative ideas of students/members in the process of solving problems is important for creating an incentive climate for the development of creative thinking and encouraging creativity (Antonijević & Nikolic, 2019).

The realization of problem-oriented learning requires to develop skills of critical thinking, skills in argumentation that contain what

someone is trying to convince others (thesis), and to assure others of the justification of such an attitude/procedure. Inadequacy of knowledge can be one of the obstacles in solving the problem (Antonijević & Nikolic, 2019).

In an ever-changing world to meet the needs of a global environmental change and societal demands, engineering leadership, governance, and critical thinking skills in harnessing technology to assist in societal needs, is required (Rahimifard & Trollman, 2018).

3.7. Holistic approach framework

There is a need for higher education institutions to adopt a 'whole-institution approach', including transformative leadership, encouraging capacity development and undertaking an assessment of the institution for sustainability and gender equality, creating a new wisdom (Lander, 2015).

Change in engineering higher education can occur within a complex system and attending to various parts of the system, creating change agents that consider factors that may influence the way in which a change initiative plays. These factors are moderators of the change process (Reinholz & Andrews, 2020).

3.8. Regional cooperation and networking

Regional cooperation among Higher Education Institutions and other non-academic partners can create networks based upon a common willingness to share and extend their experiences beyond the context of their initial community in which they worked (Dlouhá, Barton, Huisingh, & Adomssent, 2013).

Networks can link knowledge with action, enhance collective action, promote social learning (Henry & Vollan, 2014). Trustworthy networks can enhance the willingness of people and institutions to act by utilizing human and financial resources and governance structures from member-institutions, located in several countries, for the accomplishment of common goals, (Kettunen, 2005).

4. Methodology for the development of a self-assessment framework and indicators

The study reviews methods and tools, and describes the steps undertaken for the analysis and the development process of a self-assessment framework, by including both desktop and action research, drawing also on the knowledge and practical experiences of the TARGET project partners. The TARGET project evaluation framework was followed that suggests a reflexive approach.

The ideal methodology for a chance theory framework and indicators development, for us in RMEI, was a combined approach that incorporates gender-sensitive participatory methods to help ensuring that the topics of investigation are relevant to the subjects of the implementation (Reinholz & Andrews, 2020).

We decided (working group of RMEI) that change efforts should develop our own theory of change that is grounded in change theory and other approaches. In this way, our network could contextualize change theory to its character. Thus, we decided to acknowledge the complexity inherent in the evaluation/assessment and proceed with simplifying the nature of indicators by developing tailored indicators.

Complementary to a theory of change, we used the logic models which explains the resources that go into a project, the activities undertaken to produce the outcomes, and the tangible results of the activities.

Developing well-articulated outcomes and preconditions helped our gender equality working group to choose practical interventions. All methodological steps, reflections and decisions are presented below.

4.1. Rationale

Gender equity and gender equality are two interchangeable, but different notions. Gender equity is an interpretation of social justice, while gender equality reflects the equal rights, responsibilities, and opportunities of individuals, independently of their gender, as adopted by the United Nations (UN), (UN Women, 2019).

The concept of gender equality is a cross-cutting issue of social and cultural constructions of differences in women and men's social relationships (Hedman, Perucci, & Sundström, 1996). Cultural representations have a strong influence on gender equality in every society. Gender inequality is understood within a framework of social inequalities (race, socioeconomic, age, sexual orientation, disability, religion) (Friis, 2018).

Gender systems are institutionalized through education, political and economic systems, legislation, culture, and traditions (Maluleke, 2012). They differ depending on the socio-cultural context and gender roles which are learned through social processes (Dustin, 2016). Using a gender approach does not mean focusing on women and men individually, but on the system, which determines gender roles and responsibilities (Waylen, 2013). Gender equality is not possible unless men also change their attitudes and behavior in many areas (UN Women, 2019).

Gender equality in institutions/universities is a systemic change that involves cultural and structural changes. Measuring a cultural change is complicated, because culture is defined as a shared set of ideas, norms, and behaviors, common to a group of people inhabiting a geographic location. Thus, cultural change in an institutional and geographical context is seen as a change in shared values (Varnum and Grossmann (2017).

Contrary to cultural change, institutional change is broadly defined as including rules and norms with power relationships to play an important part (GenderNET Practices, OECD, 2019). To measure institutional change progress, the institution should be seen as a system with context and territorial characteristics (Bakir & Gunduz, 2017; McDonald, 2015).

Institutional transformation needs to integrate theories from education research with the aim of translating theory to practice. A key challenge is to know what actions will result to the desired outcomes, requiring a theory-driven evaluation (Reinholz & Andrews, 2020). Theory-driven evaluation aims to move beyond a simplistic evaluation making the implicit assumptions explicit, allowing an evaluator making clear connections between interventions and outcomes.

In the theory-driven evaluation of complex gender equality initiatives, the 'theory of change' framework is a tool for a team to reach consensus on assumptions by working toward understanding the conditions does which something works, and for whom it works (Reinholz & Andrews, 2020). A theory of change begins with recognizing the context in which the change effort will occur and understanding the conditions under which something works. Then, a process of reflexive mapping may start, making explicit concrete activities and medium term and short-term outcomes. Each long-term outcome is accompanied with several indicators, that describe the types of evidence. Indicators depend on the research methodologies adopted by a project. Gender positive indicators and other measurements of change are critical not only for enabling better planning and actions, but also for holding institutions accountable for their commitments on gender (Reinholz & Andrews, 2020).

4.2. Methodological and ethical questions

The organization of problem-oriented teaching/learning framework in the process of intellectual education is used in the process of gender equality learning process. This framework reflects in the solution of cognitively demanding problems and the realization of activities involving the imposition of significant cognitive effort.

For the discovery of gender equality barriers within the RMEI network and in member-institutions, a process started where we were focused at defining and analyzing the problem, knowing the structure of the problem, gathering facts to be used in the problem-solving process, establishing links between gender equality principle integrated with SDGs learning.

In this process, the methodological and ethical questions were:

(i) How to make sense of the complexity of gender equality in engineering education (engineering context)? (as discussed in section #3)
(ii) How to document and interpret the dynamics, interactions, and interdependencies of the interventions for gender equality?
(iii) How to conciliate the different perceptions, experiences, and expectations of all the actors, whether involved in the interventions or not (national context)?
(iv) How to measure the impact of the interventions in member institutions in accordance with their response and level of commitment?
(v) What indicators to create that can objectively measure progress in member-institutions without creating a ranking/judgement?
(vi) How to avoid making the self-assessment a judgement or appraisal about the worth of a member-institution?
(vii) How to assess if the process was appropriate for the national particularities (national context)?

4.3. Designing a theory of change framework for a collaborative entity (the network)

Monitoring and self-assessing are the development of relevant monitoring indicators according to the objectives, target groups and implementation contexts of the action plan. A theory of change for a change effort can better serve a project when it is developed in consultation with theory and research from the scholarly literature. In this respect, gender equality systems change in Higher Education Engineering Schools requires a multidisciplinary work, teamwork, creative thinking, flexibility to reach transdisciplinary outcomes (Kania, Kramer, & Senge, 2018). It also requires seeing the aspects of a transformative change (UN Women, 2019) which is a systemic change that refers to a process of inspiring, catalyzing formal and informal cultural changes, shaping policy, strategy and plans to generate new meanings and new visions of the future (Halbe, Adamowski, & Pahl-Wostla, 2015).

For RMEI, the transformative learning and GEP implementation was part of the vision for sustainable development towards making a shift from the wicked global challenges and inequalities, into equality in coexistence (Zabaniotou, 2020a).

In our process towards developing our own framework, for delivering an GEP (action plan) and monitoring, the approach of 'STIGMERGY' was adopted (Ballon & Schuurman, 2015; Borghini, 2017; Heylighen, 2016) which refers to addressing complex problems by self-organized collective schemes, with coordinated actions and interactions of individuals, and feedbacks.

Initially, a gender equality working group within RMEI was created which reviewed in the international literature, theoretical frameworks used by organizations, and in STEM (Science, Technology, Engineering and Mathematics) education.

We consulted two theoretical frameworks used in STEM that can inform rationale and preconditions in a theory of change of how to achieve change (Reinholz & Andrews, 2020):

a) A framework relevant to achieving behavioral change among individuals, the so called the theory of '*Planned Behavior*' (Ajzen, 1991).
b) A framework relevant to achieving organizational change, the co-called '*4I (Intuiting, Interpreting, Integrating, and Institutionalizing)* framework of organizational learning (Crossan, Lane, & White, 1999).

The 'Planned Behavior' framework explains what shapes behaviors over which individuals could exert self-control. The '4I framework of organizational learning' describes processes involved in creating, retaining, and transferring knowledge within an organization, recognizing also that learning is a multi-level process that involves individual, group, and organization scales (Reinholz & Andrews, 2020). According to this framework, the process of learning is taking the steps of Intuiting, Interpreting, Integrating, and Institutionalizing (Crossan et al., 1999):

1) Intuiting occurs at the level of the individual, while interpreting is a bridge between individuals and groups. This level is more conscious than intuiting and involves conversation and dialogue leading to enhanced mental shift among individuals and improves organizational knowledge.
2) Integrating involves developing shared understanding among individuals, and takes coordinated actions, focuses on collective action.
3) Institutionalization occurs at the organization level when new ideas and actions become embedded into routines, rules, procedures, and infrastructures

4.4. Self-assessment approaches

For a self-assessment approach, we used the S.T.A.R (Situation, Task, Action, Result) approach (Parkinson & Wadia, 2010), and the Logic Model Development Guide (LMDG) (Kellogg W.K Foundation, 2014).

LMDG was proposed by the TARGET project as it is of high relevance in helping to visualize and understand how human and financial resources can contribute to achieving and improving gender equality. This model provides stakeholders with a road map describing the sequence of related events connecting the need for planned activities with the program's desired results. The LMDG approach helped to create a shared understanding of a focus on program goals and methodology, as also it is argued in the literature.

5. Self-assessment of the network's gender equality journey

In this section we present insights from our self-assessment of RMEI journey on gender equality change, for the period of May 2017-Appril 2019, performed under the support of TARGET project. This journey is still ongoing because the TARGET project is ending in December 2021; however, many activities were interrupted due to Covid-19 pandemic (especially those that needed travels to institutions in different Mediterranean countries)

5.1. We followed a dynamic process in developing a GEP

To develop the various gender equality interventions (plan) we used the knowledge of the above models offered in the literature, our intuition and creativity; we mainly made use of the experience we have regarding the network and our schools (Mediterranean engineering institutions). In building a theory of change, our working group identified interventions that can be used and adapted to the context of Mediterranean engineering systems and especially to the network organization itself, always guided by the TARGET team.

Based on network's experiences from workshops and conferences organization, along with TARGET's technical expertise, the working group's improvised actions became the real activities/interventions. In the interpretation phase, through the dialogue and conversation that took place during the institutional workshops, with the participation of the TARGET project coordinator and supporting partners who shared knowledge and expertise, individual cognitive learning was enhanced. By exploring the engineering context and the Mediterranean cultures'

level of gender equality advancement, a mental map was slowly emerged, with levels of detail for each institution/country (of the countries participating in the process thought their members in the working group). The dialogue served to develop understanding and helped to the integration phase of the cognitive maps of the working group to develop a shared understanding and enabled a deeper meaning to evolve. Through conversation, the working group' members identified areas of difference of the of gender equality advancement/level in the different institutions of Mediterranean countries belonging to Europe, Africa, and Middle East, and developed a shared understanding of their task domain.

Individual and network's learning became institutionalized in the sense that the network created a gender equality policy that complied with the network's vision on sustainable development and supported the creation of committees/centers in interested institutions that showed willingness of the leadership. Through feed-forward processes, new ideas and actions flowed from the individual to the working group and to the network's all levels, affecting the way of thinking of people.

This process was dynamic and circular, as Fig. 6 depicts.

In developing the plan of interventions/activities, we reviewed the literature and consulted the '*River Model*' which includes a process for achieving institutional change in undergraduate STEM education (Elrod & Kezar, 2015; Reinholz & Andrews, 2020). Although, the 'River Model' opts undergraduate STEM education, its guiding intervention may also incorporate interventions at other levels of the system, such as departments and individual faculty. This model suggests eight stages: (1) establishing vision, (2) examining the landscape and conducting capacity analysis, (3) identifying and analyzing challenges and opportunities, (4) choosing strategies, (5) determining readiness for action, (6) beginning implementation, (7) measuring results, and (8) disseminating results and planning next steps. Some of these steps are expected to occur in a loop and through multiple iterations.

We also looked at the 'Departmental Action Teams' (DATs) approach that externally facilitated groups of faculty, students, and staff working collaboratively at the department's level towards a collective educational outcome. DATs focus on a single department as a unit of change, recognizing that (a) departments tend to have relatively consistent cultures, and (b) that making sustainable changes to education requires cultural change (Reinholz & Andrews, 2020). Series of shared visioning activities to develop consensus on a focal issue and set of outcomes are part of this approach, followed by analysis and interpretation of relevant data. This supports the creation and implementation of an action plan, as well as monitoring of that plan, targeting to create a sustainable structure within a department that leads to continuous improvement, rather than trying to "solve" a problem all at once. To utilize DATs for a larger unit such as our network, the project team needed to have skilled external facilitators. A multi-year effort aiming for cross-cutting improvements is needed by this approach. As the TARGET project duration is 4 years, this is a multi-year effort.

5.2. We used alternative lens

We highlighted two lenses that propose alternative ways of thinking about areas relevant to gender change in RMEI network and its members:

a) The community's cultural shift (cultural change).
b) The network's ability to inspire appreciative inquiry (institutional inquiries/ changes).

These two lenses made clear what are the strengths, weakness, opportunities and treats existing of the network (SWOT analysis). Community cultural change is a framework that recognizes different forms of capital that are resources for the network. Women capital interrelated with SDGs is a useful lens for change efforts related to broadening the discourse on gender equality in the network's member-institutions. Appreciative inquiry concerns organizational change if networks (organizations) have infinite constructive capacity to improve.

5.3. We faced national contexts complexity

In developing our methodology, we had to face the complexity of national contexts of engineering institutions-members of RMEI. This was structurally complex because many players were involved in delivery (from various member-institutions), with a variety of relationships between the actors (students, professors, university leaders, etc.) and from various national contexts (Mediterranean countries at European, African, Middle East territories) with different socio-cultural-economic variances.

This national-context complexity can create:

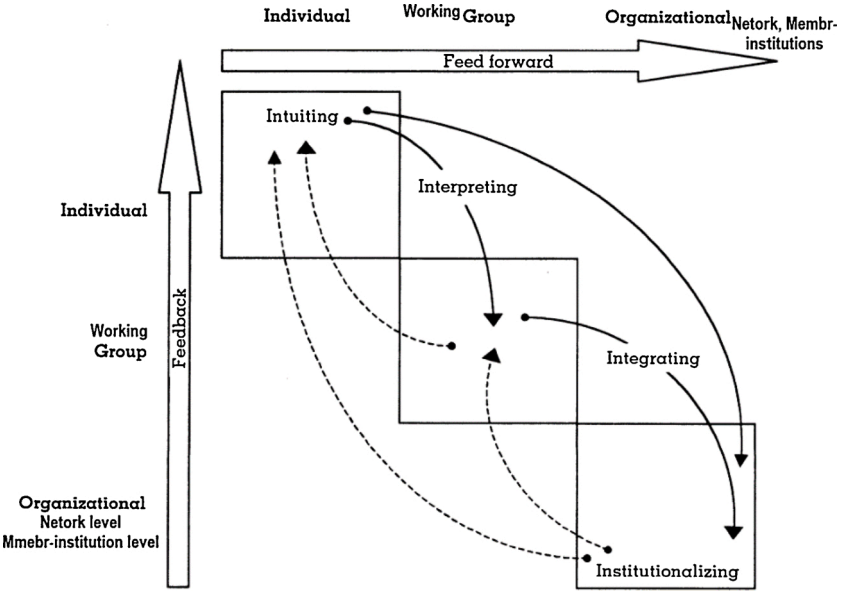

Fig. 6. RMEI gender equality learning is a dynamic process (Crossan et al., 1999).

1) A methodological complexity because it is difficult to make accurate predictions about each individual Engineering School system (member of the RMEI) with the lens of the network.
2) Disagreements among members belonging to the network, depending on the level of gender equality advancement in each country.
3) Differentiation in perceptions of individuals due to cultural differences.

These three types of complexity could create self-evaluation/self-assessment challenges. We transcended the complexity of national contexts by using co-creation processes, collaborative learning, ethical commitment to SDGs, synergetic effects, and creating common values, trustful relationships, inspired outputs, effective communication, sharing of information and resources, and top management commitment.

5.4. We took a circular approach

For the network, the starting point of the process towards gender equality change was the gender equality audit, followed by the design of a tailored GEP, implementation, monitoring and evaluation (Fig. 7).

The Logic Model Development Guide (LMDG) was applied at the different steps of the process, as proposed by the TARGET project, aiming to provide the network with a road map describing the sequence of related events connecting the need for a planned program with the program's desired results.

To design a gender equality plan, we took the following considerations, according to LMDG:

Factors: Resources and barriers, potentially enabling/hindering the gender equality strategy (GES)'s effectiveness.

Activities: Processes, techniques, tools, events, and actions of a gender equality strategy.

Outputs: Direct results of program activities that indicate the form under which the strategy was delivered to the targeted audience.

Outcomes: Specific changes expected at a longer-term from the strategy.

Impacts: Organizational, community, and/or system-level expected changes resulting from the strategy.

5.5. We created a GEP based on sustainability principles

For the design of a gender equality strategy/activities, the network is based on 12 selective principles for sustainability, borrowed from the *Bellagio Principles* (Pintér, Hardi, Martinuzzi, & Hall, 2012) (Table 2).

The activities were designed and implemented to achieve most of the network's potential. These activities are described more in details in the work of Zabaniotou (2020a, 2020b). The first and second gender equality audits were launched by RMEI in 2018 and 2019, respectively. The questionnaire included 4 sections and 49 questions. The activities of the strategy are depicted in Table 3. Fig. 8 depicts closed loops and reflexivity of the GEP.

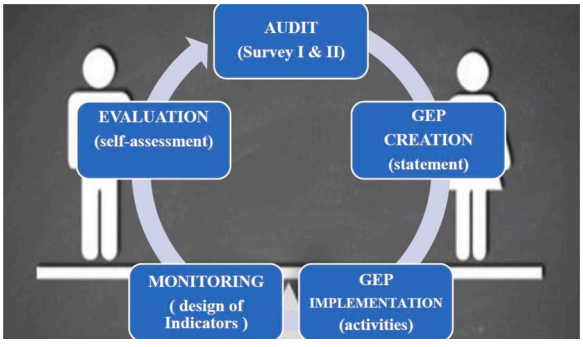

Fig. 7. Circular approach of designing a gender equality plan (GEP).

Table 2
Selection of 12 principles for the design of a gender equality plan/strategy (based on the Bellagio Principles).

No	Principle
1	Clear vision.
2	Be based on framework linking vision and goals to indicators
3	Include the whole system (network-member-institutions).
4	Build on historic and current conditions to anticipate future conditions.
5	Engage schools' leaders and ensure their participation to adopt policies.
6	Obtain a broad representation of key groups to ensure recognition of diverse values.
7	Obtain representation and active participation of the network's young students.
8	Make the methods and data accessible to all'
9	Promote the development of collective learning and feedback to decision-making.
10	Adjust goals, frameworks, and indicators as new insights.
11	Consider uncertainty because systems are complex and change frequently.
12	Use iterative, adaptive, and responsive to change approaches.

Table 3
Activities of the GEP.

No	Activity
1	Self-assembling of a gender equality working group within the network
2	Design of a gender equality audit
3	Co-creation of a gender equality statement
4	Approval of gender equality statement by the network's general assembly
5	Institutional gender equality committees structured in member-institutions.
6	Gender equality national workshops implemented.

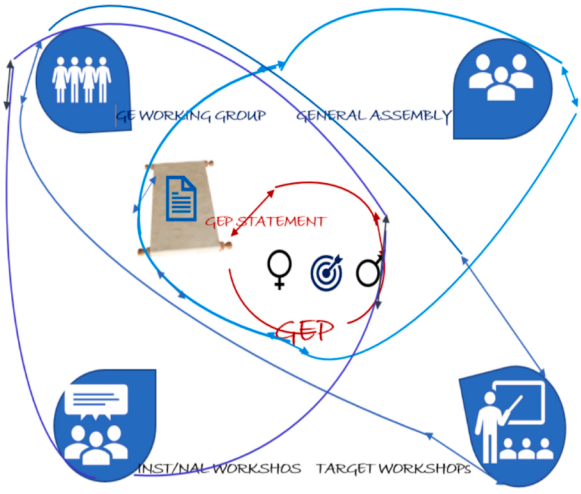

Fig. 8. Closed loops in the processes of GEP and outputs.

5.6. We obtained our short-term goals

The first goal achieved at the network's governance: 50 % of women were elected in the managing board, during the elections of the year 2018. For the president and vice-president roles, women also elected for the first time.

The second goal achieved by the creation of around 8 gender equality committee/centers in 8 member-institutions (ENISo school, Souss, Tunisia; Sapienza University, Engineering School, Rome, Italy; ENSMR school, Rabat, Maroc; Aristotle University, Thessaloniki, Greece; Technical University of Catalunya, Barcelona, Spain; Ecole Centrale de Marseille, Marseille, France, Al Najah University, Pablous,Palestine; Holy Spirit University, Lebanon).

The third goal was accomplished in policy, by the adoption of the gender equality policy statement by the general assembly of the network

in 2018, and by 10 individual institutions (as part of their policy). The gender equality statement prior to the process of voting, was brought to the attention/dialogue of local stakeholders during the national workshops to provide national stakeholders with the knowledge and support for gender equality. It is also adopted as part of their policy by 10 schools. The adoption of the statement by other members of the network is an on-going process. This creates a large community of practice.

5.7. We developed a change theory framework for monitoring and self-assessment

We first defined the context and then the changes we were envisioning, in short and long term. Our context was the engineering education at the Mediterranean countries, and the change we were envisioning were both cultural and institutional changes.

The capitalized 'theory of change' term within the evaluation community, rooted in program evaluation and social change, was not familiar to us (engineers), thus we searched in the literature and mainly we used our instinct and creativity in designing the activities (plan) and the indicators to assess the outcomes.

By searching in the international literature, we found that there are quantitative and qualitative methods for monitoring progress in gender equality. Our question was what type of method to use and what kind of data to collect. We agreed that quantitative methods are crucial to getting a global picture and to address gender disparities, while qualitative methods could enable a more in-depth analysis of gender relations and other issues that are not easily quantifiable. We decided that the most appropriate methodology for the network would be to combine both approaches.

Important cognitive recognition by the network (working group) were the following:

(i) The change that we are looking for concerns the network's system and the member-institutions.
(ii) The changes regard cultures and individual behaviors.
(iii) Although, viewing change as occurring within a complex system is important, the contextual characteristic can influence the impact of a change intervention. The change of the above systems at the engineering community are related to historical, political, and sociocultural factors.
(iv) The change theory and research can inform our understanding of the context of a change effort.
(v) The preconditions included in a theory of change should be necessary and sufficient to achieve the long-term outcome.

Finally, we used the '4I framework' and 3 assumptions to support our approach, the following:

- As the network is an organizational integrity, learning could take place at multi- levels: a) working group's members, b) students (students interact in their sub-network called GAMe), c) member-institutions.
- The three levels of network learning are linked by social and psychological processes such as intuiting, interpreting, integrating, and institutionalizing (4I's).
- Cognition could affect action (and vice versa).
- Intuition and creativity could affect planning.

Through the intuitive process, the gender equality working group perceived the network's vision on gender equality and evolved certain images about possibilities, which developed into a metaphor (e.g., committees/centers of gender quality in every institution).

These images were based upon each member of the working group experiences, from her/his institution and cognitive orientation, accompanied with energy and joy for the new creation.

At the intuitive stage actions were improvised. This means that we adopted a certain vision of the future, a certain development pathway and sets of objectives for gender equality in the Mediterranean Engineering Schools, members of the network RMEI, respecting the values sets of the Mediterranean cultures. Finally, the futures perspectives developed jointly by the members of the network implying the professors' knowledge about the Mediterranean higher education engineering systems where they exercise their functions, together with their personal desirable images.

5.8. We designed 95 practical monitoring indicators and measured the progress (quantitative outputs)

After making an extensive bibliographic review for the development of the indicators, the recommendations made by the BRIDGE report were considered (Demetriades, 2019). These recommendations concern cross-cutting and critical issues (Table 4).

For the design of indicators, we went beyond the traditional formulation, giving importance to the intersectionality of the SDG5 and its synergies with all SDGs.

We distinguished two types of indicators:

- Context indicators

These are the gender-disaggregated statistics selected by the gender equality audit from several Mediterranean engineering institutions-members of the network, providing a picture of women and men position in these institutions. They are used to raise awareness of the extent of gender inequalities.

- Performance indicators

They measure success and impact.

Finally, the LMDG was crossed with the background analysis of the network's potential for cultural and institutional change, as well as with the factors leading to these changes. This led to comprehensive lists of indicators to assess the progress of gender equality in member-institutions and to organize activities related to each case.

The designed sets of indicators and what they measured along with metrics are depicted in Tables 5–8. Table 5 presents the context indicators/metrics for the self-assessment of the gender equality audits I and II. We designed 33 indicators that concern gender-related data provided by member-institutions (scientific staff, students, measures/plans, etc.). The most important quantitative result (metric) is the response rate to the audit by the member-institutions. This reached the 50.5 % only, although the questionnaires were sent 3 times (reminding emails). This can be interpreted by three ways: a) only 50 % of the RMEI member-universities are interested in gender equality, b) 50 % of the schools don't dispose related data, c) no specific person in the school administration is in charge of responding to this kind of calls.

Table 6 presents performance indicators/metrics for the gender equality working group (GEWG) evaluation. For this assessment, 16 indicators were designed. Regarding the creation and consolidation of the working group, the listed indicators show that an inclusive, multi-generation, multi-disciplinary, multi-cultural and multi-religion working group was created. The participation to the meeting was almost 100

Table 4
Cross-cutting and critical recommendations for the development of indicators.

Recommendations
Consider qualitative and quantitative methods to generate a deeper and richer understanding of the gender equality progress.
Consider the development of specific context-relevant, gender-sensitive indicators and report on those indicators.
Establish accountability systems to track compliance with commitments to gender equality.
Support member-institutions to structure gender equalities committees.

Table 5
Indicators and self-assessment of the Gender Equality Audit (Year 2018).

	PROCESS	INDICATORS	VALUE	METHODS	FREQUENCY	RESPONSIBILITY
INPUT	Preparation of the survey	Questionnaire developed and tested Target group defined (members) Letter of information and motivation-communication sent Reminder sent	Yes	Follow – up of the survey	Every year for 4 years	Working group on gender equality
ACTIVITY	Implementation of the survey	Number of questionnaires sent out Number of reminders sent out Response rate	91 3 50.5 %	Follow – up of the survey	At the end of each survey	Working group on gender equality
OUTPUT	Analysis of the results/ Report available Presentation of results	Number of recipients of the report Number of presentations of the report	10 1	Follow – up of the workshopsAt each workshop		Working group on gender equality
OUTCOME	Discussion of results with relevant stakeholders	Audience reached by the presentations Number of key facts highlighted by the survey presented to TARGET workshops/meetings Number of interests expressed by leaders from various RMEI members on TARGET project activities, following the survey	89 9 30	Follow – up of the workshops Communication materials following the analysis of the workshop Communication to the general assembly of the network, workshops, and other activities	At each workshop, meeting and conference-related to TARGET project 4 times per year	Scientific coordinator, working group
IMPACT	Increasing awareness of relevant stakeholders	Not yet applicable				

Table 6
Indicators and self-assessment of the Gender Equality Working Group (May2017-April 2019).

LMDG	PROCESS	INDICATORS	PLANNED/ REACHED	METHODS	FREQUENCY	RESPONSIBILITY
INPUT	-Inputs from workshops -Members interested in gender equality	1. Working group members	9/15	List	For each workshop	Scientific coordinator (RMEI – TARGET)
		2. No of institutions represented in the working group	8/15	Expression of interest	3 times /year	
		3. Number of meetings and workshops	9/15	Agenda	4 times/ year	
		4. Participation of members of the working group participating in the workshops (%)	100/100	List of participants	At each workshop	
ACTIVITY	Creation and consolidation of a working group	5. No of persons in institutional workshops	12/25	Participants list	Once/year	
		6. No of universities present in workshops	8/20			
		7. No of countries represented in the working group	8/10			
		8. No of Euro-Mediterranean countries represented in the working group	4/8	Counting	Once	
		9. No of Arab-Mediterranean countries in the working group	4/8			
OUTPUT	Gender equality policy statement Collection of good practices	10. Gender equality policy statement of RMEI adopted by the network's general assembly	Yes/Yes	Follow – up of activities		RMEI office
		11. No of good practices shared during the meetings	60/100	Communication materials	After each meeting	Scientific coordinator
		12. Audience reached	200/1000	Participants list	4 times/year	
		13. Estimated number of institutions supporting gender equality policy statement	40/90	Participant list	Once	
OUTCOME	Working group established as an expert's pool for gender equality - member institutions informed about the gender equality policy statement and supported it	14. Number of scientific expertise appeared in the working group	10/46	Follow – up of RMEI activities	4 times/year	Scientific coordinator
		15. Number of initiatives for gender equality fostered by the working group	5/10	Accounting of activities	Every year	
		16. Number of gender equality centres/committees created at the member-institutions	6/12			

%, knowledge and many case-studies were shared. The information is accurate valid because we used to keep a list of participants and signatures.

Table 7 presents the set of performance indicators/metrics for the evaluation of the activities to support member institutions to develop and implement gender equality committees/structures (structural

Table 7
Indicators and self-assessment for the Gender Equality Activities (May 2017-April 2019).

PROCESS		INDICATORS	PLANNED/ REACHED	METHODS	FREQUENCY	RESPONSIBILITY
INPUT	-Gender equality policy statement	1. No of active members in working group	12/25	List of presences	4 times/year	RMEI office
		2. No of SDGs considered in vision	13/13	Mission, expertise	General Assembly	Board
		3. No of votes during the annual general assembly	40/40	Votes		RMEI office
ACTIVITY	Workshops at national level	4. No of capacity building workshops	1/2	Agenda	Once/year	RMEI office
		5. No of institutional workshops	3/3			
		6. No of TARGET national workshops	3/6			
		7. No of Michelangelo workshops	3/5	Agenda		
		8. No of participants	IW: 33 NW: 147	Participant list		
		9. Female participants (%)	IW: 33 NW:68.3			
		10. No of speakers' in the workshops	43			Scientific coordinator (RMEI – TARGET)
		11. Women speakers (%)	60.4 %			
		12. No scientific fields women-based	5	Participant list		
		13. No of scientific fields presented	12			
		14. Age of women participated	IW: 35-63 NW:24-63			
		15. No of associations participated	12/26	Participant list		
OUTPUT		16. No of strategic lines presented	43	Communication materials analysis	After each workshop	Scientific coordinator (RMEI – TARGET)
		17. No of knowledge support ppts	24/40			
		18. No of ppt available via the homepage	11/30		After each workshop	
		19. No of communication tools produced	IW: 5 NW: 8			
		20. No of YouTube made	30/30	Follow – up of the post-workshop activities		
		21. Were stakeholders been informed on results	Yes			
OUTCOME	Increasing awareness of stakeholders (relevance of gender equality)	22. No of activities planned to follow	11/15	Communication materials analysis		Scientific coordinator (RMEI – TARGET)
		23. No of data reflecting barriers	50			
		24. No of institutional barriers to gender equality	15			
		25. No of good practices shared	64			
		26. No of gender stereotypes discussed	17			
IMPACT	Establishment	27. No of gender equality centers/ committees organized	6/12	Follow–up	4 times/year	Scientific coordinator
		28. No of people involved in the gender equality centers/ committees	>30/>60	Data from the centers/ committees		

change). 28 performance indicators were designed. The goals are reached, many stakeholders participated in the national workshops and many facets of gender equality were addresses. The information is accurate and valid because we used to keep a list of participants and signatures.

Table 8 presents indicators/metrics for the dissemination activities evaluation. 18 performance indicators measured the dissemination plan and the assessment. The audience to the workshops reached 400 persons, which is a high number taking in consideration the contextual difficulties. Many interviews were performed and many visits to the devoted social media were accounted.

6. Assessing the network's self-assessment framework and indicators

For developing the self-assessment framework, we took an iterative, adaptive, and responsive approach to change and uncertainty; as engineers we acknowledge the systemic approach and systems complexity.

Our approach proposes to tackle the challenges through accepting that complexity requires interdisciplinarity, and that indicators should represent a limited number of key issues for analysis to provide a clearer signal of progress. We gave much important to define questions and tools, gender-sensitive criteria, to ensure the participation of all stakeholders in the process. The framework discussed among the Mediterranean stakeholders through the institutional learning workshops, the national workshops organized in different Mediterranean countries, the capacity building workshops organized in the frame of the TARGET project by the different project's partners.

Self-assessment was an integral part of all planned activities aiming to build evidence and to invest in further work, to ensure the effective use of resources that TARGET project provided. It was important to plan the self-assessment to ensure that it is as productive and useful as possible taking a framework that followed a flexible five step process:

(i) Agree on who will carry out the evaluation and, on the way to how the involved the stakeholders in the process, and on the timetable.

Table 8
Performance indicators and metrics for the assessment of the dissemination activities.

	INDICATORS (May 2017-April 2019)	VALUE
ACTIVITIESAUDIENCE REACHED	1. No of presentations on TARGET in international conferences by RMEI members	3
	2. No of papers on TARGET published by RMEI members	3
	3. No of contributions to editions of worldwide reports	1
	4. No of newsletters published by addressing the project challenges	2
	5. No of interviews released on the project on the internet	40
	6. No of social media used to communicate the project	2
	7. No of publications about the project on Facebook	60
	8. No of documents about the project published on RMEI website	10
	9. No feedback from Mediterranean academic actors on the question: "Why is gender equality important to you?"	15
	10. No of conference audience where the TARGET project was presented by RMEI	100-400
	11. No of TARGET interviews	40
	12. No of followers on Facebook	1372
	13. No of followers on Twitter	248
	14. No of visits on RMEI website and TARGET page	4324
	15. No of visits on RMEI website for the gender equality policy Statement	2123
	16. No of views on RMEI website for TARGET workshops announcements	95-100
	17. No of visits on RMEI website on TARGET documents	682
	18. No of visits on RMEI website on the TARGET gallery	2392

(ii) Clarify aims and objectives, making sure the objectives are SMART (Specific, Measurable, Achievable, Realistic and Time-Bound).
(iii) Identify expected impacts and outcomes that fit in the objectives, making sure that they relate to both the network and the member-institutions.
(iv) Decide what quantitative and/or qualitative information is needed and how to be to be collected, being realistic about what is possible, trusting the sources to strengthen evidence generation.
(v) Analyze and interpret the data to identify key findings and generate learning and evidence and present it in a report for the EU and member-institutions.

The self-assessment was focused at two levels:

A At network level with the aim to:
- Evaluate how the gender equality policy/plan and the related statement accomplished the network's vision.
- Identify the gender-sensitive organizational changes occurred since the creation of the gender equality working group under the TARGET project and the degree of gender-balanced structures.

B System level (member-institutions):
- Whilst assessment of the network's individual components is a crucial part of assessing the worth of the gender quality initiative, it does not by itself provide feedback on the change of the overall whole system of engineering education schools (member-institutions). In order to capture the possible 'added value' of whole system (network and members) and build evidence of inspiration and catalyzation effects of the network vision on the member institutions, the activities/workshops of the community of practice were evaluated and the impact assess in qualitative and realistic simple way.
- Non-linear approaches looking at the whole and mapping and understanding the interrelationships, interactions, and synergies regarding SDGs the engineers work on, were also evaluated. This was surely a much more challenging endeavor than evaluating network's components.

The boundaries of the self-assessment endeavor were:

a) First, we did not look at the effectiveness, whether the approach taken, and methods used were the most cost-effective and/or whether the benefits justified the costs, since we were 'positioned' by the budgeted workplan of the TARGET project.
b) Secondly, we evaluated short-term impacts and whether we accomplished the network's visions and TARGET's aims and objectives.
c) Third, about the process, we did not meta-questioned whether the way that we took to implement the initiatives were appropriate for the particular circumstances because the initiatives were decided unanimously in the working group during the institutional workshops and confirmed by the devoted leading us-TARGET partners.

While we have proposed a wide-ranging, well-developed conceptual self-assessment framework for capturing the complexity of interventions and their effects, finally simplification of the concept was made for the sake of measurements. We paid attention to design gender- and context-sensitive indicators to fit into engineering and Mediterranean contexts. We considered the multifaced challenges of the impact assessment with instances of the gender equality interventions integrated in engineering education for SDGs. We looked at synergies between interventions for SDG5 and SDGs.

In accordance with the presented framework, we did not use only rigorous methodologies, and analytical tools. We used our creativity, and an evidence-based approach to design 95 case-specific indicators for the estimation of the impacts of the gender equality journey (gender equality audit, working group, activities including workshops, dissemination activities). It might be argued that current indicators are largely activity-centered, but this is what a network of engineers (who do not know theories of social changes), can mostly do: practice and development of a community of practice (they are practitioners).

It might be seen that not all indicators have an unambiguous meaning, e.g. the number of initiatives for gender equality connected with other SDGs undertaken by the working group members-engineers. To give meaning to this indicator, the added value of the interdisciplinarity approach was considered. By using the interdisciplinary lenses to look at what the above indicator counts for, it can be argued that this indicator counts for the number of engineers who were inspired and motivated to unlock their capacity to think gender equality and to act (take initiative) in their academic work. This is a very important shift in scholars-engineers' thinking and acting, because engineers' traditional domain of practice is the technological innovations domain and not the social innovations one (e.g. gender equality). Therefore, this indicator is contextual and very important because it measures a shift in the practice of engineers. This is what we call transformative change.

While we cannot rely exclusively on gender indicators for measuring the impact of the processes that the network has taken towards a cultural and institutional gender equality change, these indicators, however, can provide an important starting-point and the insights required for more detailed policy in each institution- member of the network.

Indicators that measure the efficiency of promotion systems in universities, in terms of gender balance, the level of equal opportunities in academic careers and balance with the family life, the male-female ratio within the management of faculties and schools, are indicators that have to be developed within institutional policies/strategies/plans, being beyond the RMEI network's legitimacy. Over time, hopefully, member-institutions may come to reflect on a gender-balanced social

organization of life and work within their institution.

Finally, we wish to mention that the approach taken in this study is based on interdisciplinarity. Due to the complexity of current wicked gender equality problem, recognizing interconnections with other disciplines, an interdisciplinary approach is required. The fact that a network of engineers takes the leap towards learning and acting for a systemic social change (gender equality) is very positive and innovative.

7. Assessing impacts

The direct impacts (quantitative) were discussed in the previous section with the direct measurements by using quantitative indicators. In this section, we discuss the indirect impacts (qualitative) of the customized GEP (Table 9).

8. Conclusions

The RMEI network has effectively developed meaningful processes/structures for gender quality strategies, formulated practical guidelines and best cases, and built a community of practice. Network's clear vision on sustainable development through education has catalyzed the gender equality learning and commitment of the members.

The network proved that has the potential of inspiring the institutional change at the members-institutions due to collaborative learning, exchange of knowledge, best practices sharing, the different way information flows and trustful relations.

It is shown that networks can play an important role in developing effective cross-disciplinary partnerships including the creation of a common 'trading zone' in which the scholars agree on fundamental principles, problem-definitions, and theoretical and methodological assumptions.

The collection of segregated data is not enough to ensure progress on gender equality at the member-institutions, especially in the context of limited capacity, and even more in the context of limited resources. Gender-sensitive measurements alone do not improve gender equality at the members of the network, either. Instead, willingness of the institutions academic leaders to proceed towards a gendered-balanced governance and operation of their institution and enhance commitment to SDG5, are key components for a successful outcome.

The use of standard approaches, rigorous methodologies, and analytical tools for the evaluation process of a gender equality plan is not always obvious. There are strong relationships between conceptualization of knowledge and knowledge exchange resulting in different approaches to knowledge exchange and evaluation methodologies depending on the research field and context. Indicators can be tailor-made and case-specific respecting the normative values of the context.

Integration of students of the network in the gender equality change learning and acting with creativity can bring an effective revolutionary change by creating the future change agents.

Authorship contributions

Category 1: Conception and design of study: AZ, AT Acquisition of data: AZ. Analysis and/or interpretation of data: AZ, OB, AT Methodological appry: AT, AZ.

Category 2: Drafting the manuscript: AZ, OB. Revising the manuscript critically for important intellectual content: AT, AZ.

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Table 9
Assessing the indirect impacts of RMEI customized GEP for the period from May 2017 to April 2019.

Assessment	Impact	Justification
High	Consolidation of network's vision.	The network's gender equality policy was formulated according to the network's clear vision and mission inspiring the commitment to SDGs and sustainability values which is reflected in the network's gender equality policy statement that calls for actions to pursue gender equality with a view to strengthening peace, stability, equality, and prosperity in the Mediterranean region. TARGET project was the supporter of RMEI in consolidating vision and goals.
High	Simplification of essential elements	We adopted a time horizon for gender equality activities that is 4 years, as the duration of the TARGET project, thus responding to current short-term decision-making needs. We designed activities to engage decision-makers and to obtain a broad representation of key groups, professors, deans, rectors, and students towards ensuring the recognition of gender equality dimension. To ensure the participation of decision-makers in adopting the gender equality policy and the resulting action plan, we used the network's annual General Assembly as the platform to achieve the highest participation of member-institutions' leaders.
Neutral	Segregation data	Availability of segregation data was not accomplished due to the lack of organized data collection in member-institutions. There are varieties of cases: Across the European-Mediterranean institutions gender-disaggregated are more available compared to the data provided African and Middle East Mediterranean countries (see Table 5).
High	Practical focus	The designed indicators are simple in structure, using a clear and plain language. In this regard, the participation indicator at the local workshops and committees is a useful indicator of the relationship between males and females in the academic life. The indicator of stakeholders is a useful indicator reflecting the probability for wider changes. It gives an indication of the level of the society's maturity to open and maintain a dialogue on gender equality (Tables 5 and 7).
High	Transformative learning through commitment	Sustainable development implies constant evolutionary, self-organizing and adaptive change, while gender equality is a prerequisite to this. The concept of a systemic change and the commitment to sustainable development by members of the network enabled the introduction of a gender equality as the prerequisite of the SDGs innovations within the network. Communicating actions on climate change and environmental problems as having synergies with gender equality had an impact on many network's members thinking. We define this as a transformative learning. This is evidenced by the decisive unanimous positive voting of the gender equality policy statement by the member-institutions' leaders during the general

(*continued on next page*)

Table 9 (*continued*)

Assessment	Impact	Justification
		assembly 2018, in Rome. This was the highlight that inspired and facilitated the change of the network's governance towards a gender-balanced board, reversing the traditional men-dominated pattern of the board that followed since its creation. Women elected in the board of the network, in a gender-balanced 50/50 rate. Women were elected as president and vice-president for the first time in the history of the network.
High	Tracing the holistic perspective	By taking a tailored, bottom-up and case-specific approach, the network is driving the awareness and mobilization of gender equality change, by tracing the empirically of the implications at the network's level (board, working group, policy, strategy), and at the universities-members.
High	Inspiring cultural change	The network catalyzed the evaporation of some gender equality biases through the trustful interrelations, interactions, and interchanges among the members of the network and due to the behavioral 'SPILLOVER' phenomenon (spillover is where the adoption of one behavior causes the adoption of additional, related behaviors) (Galizzi & Whitmarsh, 2019). However, it is obvious that to address gendered norms and stereotypes, we need a broader and more in-depth eye entailing tackling gender ideologies and practices in societies and families (Lomazzi, Israel, & Crespi, 2018).
Good	Catalyzing institutional change	This study shows that a network can create a collective dynamic of individual stakeholders; it is a good platform for creating a dialogue for institutional change towards gender equality at many scales. However, change at each Engineering School is very much dependent on the school's leader's willingness to proceed with the institutional transformation, the capacity to identify, reflect on, and address gender bias in a sustained way. Therefore, implementing gender equality is mostly a political decision rather than a technical exercise. Finally, the network can only inspire and catalyze the change due to the different way information flows and responsibilities are distributed, in comparison with hierarchical academic institutions.
Good	Region-specific impact	The network's GEP fits the specificities of the Mediterranean countries and the engineering education context. Local cultures and religions were respected. However, only 15 universities from the 28 remembering are active in the RMEI GE journey.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests that could have appeared to influence the work reported in this paper.

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