



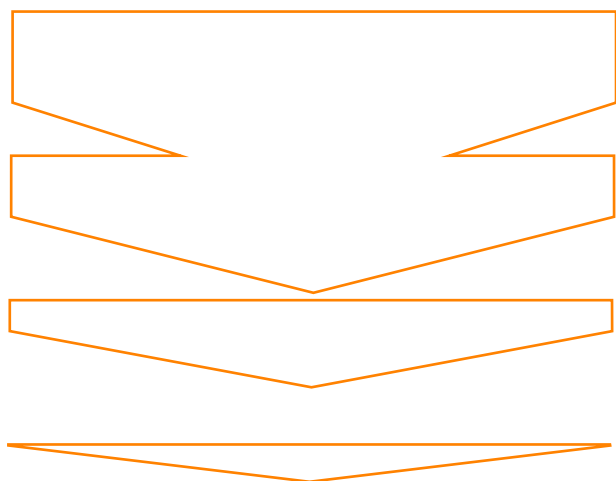
EXECUTIVE SUMMARY

TRAINING THE 21ST CENTURY ENGINEER

For the integration of socio-ecological stakes in engineering training programs



EN PARTENARIAT AVEC
GROUPE
INSA



THE ENGINEER, A KEY PLAYER IN THE ECOLOGICAL AND ENERGY TRANSITION

Leading the transition to a decarbonized and resilient economy and society is a challenge that concerns all sectors of society. This implies training all students in socio-ecological issues, albeit in a differentiated manner, in all disciplines. The engineer, because he or she is historically situated at the crossroads of societal objectives and material contingencies, is a determining factor in the socio-ecological transition. Managers, designers, and others must **integrate into their analyses and decisions the climate changes at work, the collapse of biodiversity, the increasing scarcity of available resources, especially energy, and the social consequences of these disturbances.**

However, engineers are still poorly trained in these issues. Only 26% of courses addressed these issues in mandatory

engineering school courses in 2019. **78% of engineers surveyed believe that their higher education did not train them at all or not so much in these issues, and 95% consider that they should be included in initial engineering training.** The INSA Group, aware of the magnitude of the challenge, wanted to join the Shift Project to experiment with the integration of socio-ecological issues in all of its initial training courses, and to draw useful lessons for other higher education institutions.

The urgency is indisputable : the economy and society need these actors today, but it will take 5 to 10 years for graduates capable of putting new skills into practice to be able to initiate changes in companies, communities and associations. This vast project must start today !

This Executive Summary is accompanied by 3 documents, each with its own audience and content :



VOLUME 1

Manifesto

The manifesto focuses on the objectives of the training, the content to be taught and the way to do it (repository of knowledge and skills, engineering techniques, pedagogical approaches and program of courses over the duration of the training).

It is intended for teachers, training directors and educational engineers, but also to students who wish to use it



VOLUME 2

Methodological guide

The guide proposes a method to initiate the evolution of training programs in order to train engineers able to contribute to a resilient and low-carbon society. It presents the steps to follow, the role of the various stakeholders and the means to be implemented.

It is intended for managers of an institution, a training program or a department but also to any stakeholder wishing to engage in this change: institutions, teachers, students...



VOLUME 3

Experience feedbacks

The experience feedbacks present the work carried out between The Shift Project and the INSA Group (methods, review of the situation, evolution of training programs) as well as various initiatives and experiences of the engineering education ecosystem.

They are intended for all stakeholders in engineering education, particularly departments or programs directors, students and teachers.

HOW CAN WE ENCOURAGE AN APPROACH THAT MEETS THE CHALLENGE?



Guide for engineering programs stakeholders

Take the measure of the challenge : train all its students, transform all its training courses, beyond awareness, into training for understanding and action. Integrate the fact that what will be valued tomorrow in a transition framework is different from what is favored today, implying an uncomfortable intermediate phase.

Redefine its institutional strategy in order to integrate socio-ecological issues in an ambitious and coherent manner in its teaching, research, campus, practices and partnerships.

Initiate and perpetuate a prospective reflection on the evolution of trades and skills in the medium and long term with regard to the challenges of transition.

Involve and mobilize all its staff and stakeholders : board of directors, pedagogical managers, teachers, students, etc.

Create and facilitate communities of practice in order to promote the sharing of experiences and resources, and create emulation within the institution and with other institutions.

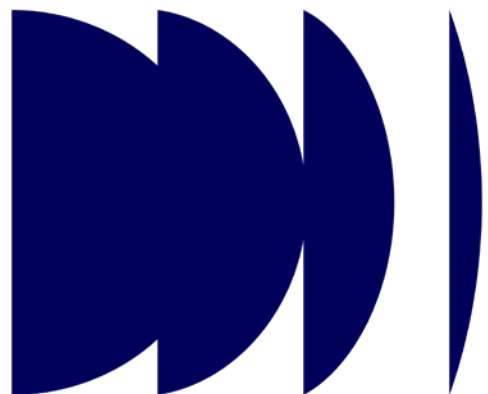
Diagnose your starting situation and identify the assets you can rely on (teachers, partners, etc.).

Mobilize human and financial resources in line with the transformations to be carried out in the service of this priority project. **3% of the operating budget during 3 years.**

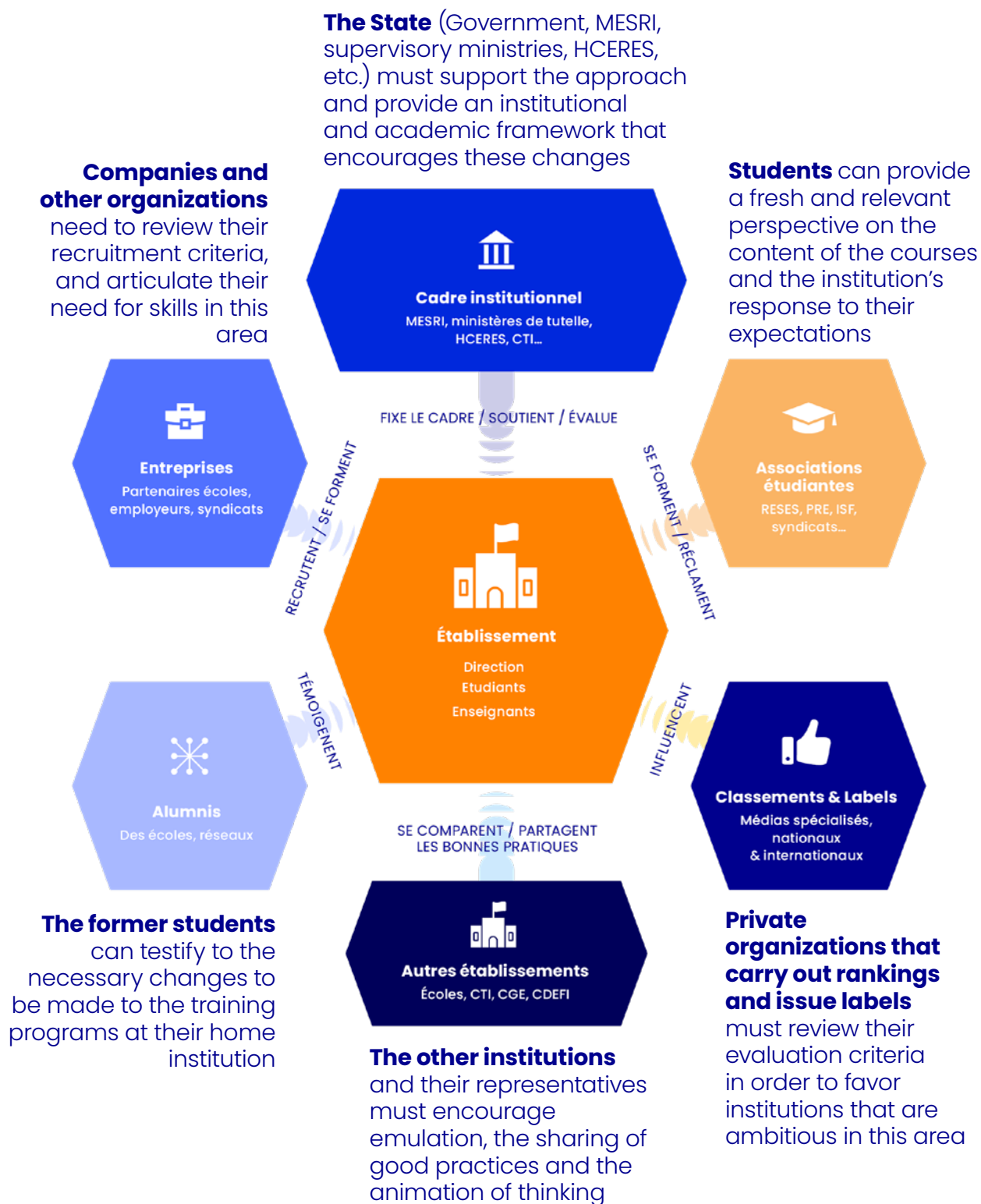
Adopt a common base of knowledge and skills in consultation with all stakeholders in the institution.

Integrate this base into all curricula and its application by field of study within the framework of a coherent educational program, and do not hesitate to replace certain courses if necessary.

Train all staff (including management and administration) in socio-ecological issues.



HIGHER EDUCATION, A COMPLEX SYSTEM TO MOBILIZE TO SUPPORT INSTITUTIONS (THE FRENCH CASE)



BENEFIT FROM THE EXPERIENCES ALREADY MADE



Experience feedbacks

The Shift Project, the INSA Group and other actors wanted to share their experiences, in all humility, in order to catalyze changes in the higher education ecosystem. This collection of feedback shares :

The context in which this pilot case with the INSA Group was made possible, including student mobilization and management commitment.

The implications of such a commitment and the conditions for success: collectively defining the issues at stake, thinking about the general strategy of the institution in a changing society.

The methods used, such as co-construction, training of the actors involved, the choice of tools (inventory, reference framework) or the facilitation and support of the groups.

The conclusions of the inventory of the INSA Group's training courses : number of courses and time volumes throughout the curriculum, dedicated or not, analysis by training field, by key words, identification of strengths, etc.

Feedback from each INSA Group institution and from other initiatives, identifying the context, the method used locally, the actions already taken, the next objectives and the obstacles and levers.

This document demonstrates how:

Taking socio-ecological issues into account in training is a large and complex undertaking.

It is necessary to take each situation into account : the DNA and culture of the institution, inclusion in its territory, particular fields of application, staff, existing partnerships, initiatives undertaken, changes at work in the local ecosystem...

Collective work that goes beyond the boundaries of each school is necessary given the urgency of the situation, and is fertile : the actors in this change are all asking the same questions, are all looking for the same types of support, and cannot find it only in their school. Some teachers may feel alone on specific integration issues, but potentially already worked on elsewhere. Many of these skills or knowledge are new and unstabilized, so outside help is essential.

REPOSITION ENGINEERS IN A GLOBAL TRANSFORMATION OF OUR MODEL OF SOCIETY



Manifesto for the evolution or engineering training

The Shift Project calls on all stakeholders who train, employ, or represent engineers to reflect together on how engineers can contribute to a socio-ecological transition project. This Manifesto makes several proposals:

It poses the need to adopt a vision of the socio-ecological transition, based on preferences collectively defined according to a search for the general interest, in a controllable and normative approach.

It invites us to reflect on the role of the engineer, historically, currently and in the future, and on the evolution of engineering professions in a resilient society: the disappearance, appearance or evolution of professions must be anticipated for medium and long-term employability.

It attempts to identify the room for maneuver available to engineers at the professional, individual and collective levels, whatever their position.

It proposes to discuss a base of knowledge and skills necessary for all engineers to play their role in the socio-ecological transition,

It hopes to provide a draft response to a strong expectation on the part of students, but also teachers, as well as to the growing need of companies for new skills to successfully carry out their transition

A REPOSITORY OF KNOWLEDGE AND SKILLS THAT IS ACCESSIBLE AND ADAPTABLE TO ANY INSTITUTION

This Manifesto is designed as a tool for pedagogical managers and teachers, and proposes concrete material for the evolution of training courses (content, time volumes, pedagogical practices, etc.).

It proposes a repository of knowledge and skills for engineers, sourced, free of charge, adaptable to any training.

It aims to structurally integrate socio-ecological stakes into engineering training programs.

It proposes to position engineers as facilitators and educators (among others) of the relationship between technology and society, thanks to their fundamental technical knowledge, their scientific approach and their ability to popularize technical phenomena and their impacts.

It insists on the need to integrate more human and social sciences and cross-disciplinary skills into training programs (systemic, ethics, co-construction, etc.), reminding us that the

solutions and innovations that will enable us to respond to current and future crises will not be based solely on technology.

It recommends the integration of compulsory courses that meet the repository (dedicated or not, as part of the core curriculum or as a speciality), 200 hours of which would provide a very good basis for understanding.

It also invites the development of innovative and active teaching approaches, better adapted to these issues and facilitating their integration into existing programs.

It reminds us of the importance of rigorously training engineers to measure the physical and social impacts of their activity, throughout the life cycle.

It urges engineers to review their way of designing and producing, according to the motto «primum non nocere» (first, do no harm).

THE CIVIC-MINDED ENGINEER FOR THE 21ST CENTURY

THE SOCIO-ECOLOGICAL STAKES

