Empowering youth on entrepreneurship for the SDGs:
the case of a high-school contest on sustainable and innovative ideas.

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1.Introduction. The era of the Great Acceleration: human intelligence at the stake of complexity, uncertainty and anxiety

The era of the Great Acceleration is characterized by complexity (Simon, 1962; Holling 2001) uncertainty (Courtney et al., 2000) and anxiety (Horizon, 2020). and by the presence of multiple systemic risks related to the survival and sustainability of the planet Earth. An era that contrasts with the one behind us defined as one of Relative Climate Stability (MGI, 2020b).

One of the causes of the Great Acceleration is, from the mid-twentieth century, the Anthropocene (Crutzen, 2002; Ruddiman, 2013), a concept for which human activity has begun to intensify its effects directly on the entire Planet Earth by modifying the structure and functioning in particular for the accelerated evolution of technologies that emerged from the first industrial revolution (Steffen et al., 2004, 2015). The new era of the Anthropocene, which finds its roots in Antonio Stoppani's definition (1873), as a new telluric force which in power and universality may be compared to the greater forces of earth (Lucchesi, 2017), is characterized as a moment of rupture with the previous era of the Holocene. On the basis of these premises, various authors have described (Polanyi, 2000; Gaffney and Steffen, 2017) this crucial phase of profound holistic and interlinked nature of the post-WWII changes simultaneously sweeping across the socio-economic and biophysical spheres of the Earth System, encompassing far more than climate change, as the cause of the great acceleration towards critical survival scenarios, and which can be further defined as Planetary-Scale Coupling between the socio-economic system and the biophysical system (Steffen et al. 2015).

But what does it mean to have entered the era of the Great Acceleration? According to Lombardi (2021) the context in which we operate can best be defined as the era of the *Great Acceleration of complexity, uncertainty and anxiety*. If we take this position, we must start from two propositions. The first refers to the presence of interconnected biophysical processes on a planetary scale that define the plot of reality. This is the recognition of the role of new technologies and their pervasiveness as well as their interpenetration with the multiple spheres of reality. In fact, we live in a hyper-connected world where the boundaries of ecosystems have been reduced if not canceled with respect to information, energy, material and human flows. The second proposition states that biophysical processes are increasingly bio-informative. In the dynamic and hyper-connected world mentioned above, where bio-physical and techno-digital systems intersect, global systemic relationships emerge as build structured interdependencies between processes and phenomena or eco-social sub-systems. These new relationships are structured on affinity, complementarity, convergence of interests and belief systems. These two propositions require the attempt to analyze deeper the effects of the processes described above in terms of societal challenges and the mechanisms that favor the realization of a strategic effective answer to these challenges.

The analysis will necessarily consider the Planet Earth as a *complex* adaptive system (Levin 1988): a set of components with freedom of action that operate in ways that are not always mutually compatible and whose behaviors are interconnected to the point that the dynamics of each change set the context for the others (Plsek and Greenhalgh, 2001). Complex systems are recognizable for a) non-linearity, where systems evolve according to dynamic and transversal processes, behaviors and flows at different levels of reality and scales; b) the presence of *unpredictable* emerging *phenomena*, processes that can be triggered by many causal factors and whose outcomes are unpredictable and not related to their scale (e.g. pandemic, nano-scale change, global and unpredictable chain effects).

Complexity and unpredictability are in turn connected to *uncertainty*, where uncertainty refers to what happens at the micro scale, at the scale of the agents who will inevitably have to choose and act in conditions of fluctuating uncertainty caused by the incessant reproduction of cognitive gaps between what agents (individual and collective) can know and the informative feedback received as a result of combinatorial dynamics between accelerated and not completely known multi- or cross-scale processes (Lombardi, 2021). Complexity, unpredictability and uncertainty must be considered as *stimuli* to seek first of all a profound change of perspective. This change should lead to new strategies characterized by the exploration of possible trends and potential trajectories and the elaboration through experimentation of not-predictive multiple scenarios. In this context, the sources of '*anxiety*' are multiple (Horizon 2020; Economist, 2020), as already studied by Mokyr et al. (2015) in the forms of fear of the loss of work, of well-being, of distributed wealth, of a socio-economic nature such as future pandemics, economic-financial crises, wars. Thus the acceleration of these dimensions of complexity, uncertainty and anxiety make the **dynamics of knowledge** strategic forces to design effective responses to societal challenges at different scales (Lombardi, 2021).

1.2 The Great Acceleration – responses at the international level

The concepts of tipping point (Gladwell, 1962) and critical transition (Markard et al, 2012) have become central themes in the analyzes and theories on the evolution of biophysical processes, following the nature and morphology assumed by human economic-productive activities. On a global and international level, global institutions as well as consulting groups and research and technology centers have begun to outline this phase starting from the recent economic-financial crisis (2007-09) but above all from the spread of the SARS_Covid19 pandemic since 2020. There is a widespread awareness that socio-economic systems need to be 'reset' on new foundations. This is the case of the Great Reset (WEF 2020), for which there is the need for 5 steps to reboot business in the COVID-19 era: Reflect, Recommit, Re-engage, Rethink and Reboot and related building blocks: changing mindset; evaluating the factors of change with new metrics; reducing the distance between leadership and the life of the rest of us (WEF 2020). For the Boston Consulting Group (BCG 2020), the answer must concern the organizational level, the company, proposing hybrid organizations capable of learning through the application of human and artificial intelligence. Doing so would effectively activate those levers such as effective approach to change, leveraging human diversity for resilience and innovation, and the creation of trusted, purposeful organizations, which would help the organization to learn quickly in the face of rapidly changing processes in order to acquire resilience. For the McKinsey Global Institute (MGI 2020b) the emphasis should be placed on people and in particular on leadership for which leaders, in the face of dynamic and unpredictable scenarios, should rely not so much on plans prepared in conditions of planned stability and certainty but on behaviors and mindsets that will prevent them from overreacting to yesterday's developments and help them look ahead. For Young and Reeves (2020), the transformation requires a deeper change that touches the business models of companies, thus overcoming the model of business as usual (short-term profitability, maximization of shareholder returns) with the adoption of innovative business models based on sustainability and stakeholders interests. The latter is confirmed by a synthesis that combines the three pillars of sustainability and the role of booster of technological innovations. In fact, for the International Monetary Fund (IMF) to overcome the great critical acceleration it is necessary to focus on strategies based on three fundamental components: digital transformation, going green, building fairer societies (IMF 2020). Fundamental areas then become digital innovation, global environmental sustainability, equity and the reduction of inequalities and people with profound changes in training processes (OECD 2020). Adding to the tipping points of ‘20s (the economic-financial crisis, the consequent socio-economic inequalities, and the global pandemic) the seven long-term climate change impacts of the Anthropocene (MGI 2020b) (1) High growth of the same risk; 2) Local specificity of its manifestations; 3) Non stationarity; 4) Non-linearity; 5) Systemic nature; 6) Regression; 7) Unpreparedness) will increase the power and impact of the three dimensions of the Great Acceleration. As a reaction to that, the trajectory towards a Green Planet has already been present for many years in many studies, reports and programs (Meadows et al, 1972, UN 1987, UN 2015, IPCC 2019), while since the early 2000s international research centers have indicated that our

Planet is close to a tipping point from a climatic point of view (Lenton et al. 2008). It seems reasonable to believe that today's biophysical, social and economic processes are subject to a strong multidimensional stress, which requires a profound rethinking of the models of life, production and consumption.

2. Background. Adaptive strategic thinking as an effective strategic and operational mindset for accelerated times

If the socio-economic system with its organizational models of production and consumption is faced with great challenges and new unpredictable risks (WEF 2022), many of which are linked to the theme of sustainable development, how to respond concretely at the level of younger actors to give them new mindset and operational tools that make them ready for the next challenges in the job market and beyond? Before responding by presenting the case and discussing it, we introduce the conceptual reference model which the project is inspired by.

2.1 Theoretical frame at the macro level: strategic thinking

The techno-economic transition continually feeds on bottom-up and top-down strategic and operational designs that must however be coordinated in relation to the complex, dynamic and multi-dimensional problems of society (Wanzenbock, 2010) that require multilateral governance to govern the world in a sustainable and competitive way.

What is the best strategy? Our theoretical framework within which our strategic thinking is mainly based on the works of Olson, Mokyr and March. Olsson (2000, 2005) introduced the concept of 'Ideas Space' as a universal set of all possible ideas. Within this space, Mokyr (2005) focuses on ideas related to technology, in particular to the concept of *useful knowledge*, a crucial ingredient for the economic growth of our systems. The useful knowledge is divided into two types of knowledge: a) *propositional,* which includes everything we think we know, also called *Episteme*. Epistemic knowledge is the basis of the regularities of nature that we know, the basis with which we create knowledge and things. This one introduces the second knowledge (b) called *instructional* or *prescriptive* knowledge defined as *Techne*. Technical knowledge includes instructions on how to produce or exploit the regularities of nature to increase the well-being of humanity.

Thus, the space of ideas can be divided into 2 sub-sets, epistemic and technical knowledge (rules organized in the form of instructions). For March (1991) in the E*pisteme* we have the *exploration* activity, while in the *Techne* we have those of *exploitation*. A further important point for our conceptual framework is the third point: the continuous *mapping* between Episteme and Techne. The new techno-economic paradigms are adopted thanks to a continuous mapping between the two spaces of ideas. Human knowledge can then be seen as an evolutionary process characterized by a perennial mapping between episteme (exploration) and techne (exploitation), the latter faster in its evolution than the former. For the competitive challenges that the new complex scenarios bring to companies and people, the latter respond by trying to develop a set of alternatives that are able to design effectively new trajectories in an open and dynamic way. Actors therefore try to explore new regions in the infinite space of knowledge through a generative process characterized by changes in the technical-scientific rules through the increase and modification of existing knowledge, resulting into recombination of sets of (epistemic) existing and new rules together with evolutionary changes in the technical components of the Techne space (Lombardi, 2021).

The era of uncertainty and complexity implies that decision-making processes must simultaneously address a set of variables and processes and factors that are partially and incompletely known.

In this context, the traditional micro approach to planning is doomed to fail, based as it is on the assumption that powerful analytical tools can make it possible to arrive at a clear decision about the future. The risk of not perceiving the signs of real change or the inherent threats is very high, especially if the decisions are based on intuition and not on the rigor of the analysis. For this, it is necessary to put a different strategy at the center of decisions making process, changing the paradigm that must be based on flexibility, openness and adaptivity.

The framework adopted here refers to a space of ideas (*episteme* + *techne*) that companies could face according to 4 levels of uncertainty divided into two categories of strategically relevant information (MGI, 2000a). The two levels of information refer to an information that allow for the

precise definition of the evolutionary trends of the processes and that can help detect unknown factors but cannot resolve an area of residual uncertainty. The first two levels of uncertainty (1,2) regard decisions taken at the lowest risk, while levels 3 and 4 are the riskiest ones. In fact, level 3 includes situations where the set of knowledge is incomplete and confused and where it is possible to outline a set of potential technological trends or related production and consumption models but not such as to be precisely defined. This space includes a large part of today's decision-making processes in the technical-scientific, economic-productive and health fields (e.g. Industry 4.0; COVID-19). Level 4 concerns the interactions between the dimensions' decision and uncertainty at a level that is impossible to predict (e.g. Quantum computing).
Today the actors find themselves operating mainly between levels 3 and 4, where strategic thinking becomes fundamental to proactively address the high levels of uncertainty and related risks.
It is therefore necessary to change the strategic and operational mindset by moving to a decision-making model of continuous exploration that will allow actors to adapt in a flexible way to unpredictable events and scenarios. It becomes necessary to start from the inherited basic knowledge without canceling or deleting it but adding activities of exploration of new knowledge domains through flexible and agile cognitive schemes, which in fact open the possible decision-making and operational outlets to reduce the risks of limited rationality and cognitive incompleteness (Simon, 1976, 1978) through access to interdependencies and informative feedback. The approach of strategic thinking must therefore be enriched by a systemic vision that will introduce the formulation of guiding hypotheses, the verification of hypotheses on the basis of information and feedback signals from theoretical and practical research fields, as defined by Liedtka (1998) and confirmed by Moon (2013) for whom the essential elements of strategic thinking are based on the three pillars of systemic vision or systems thinking, the creative vision or creative thinking, and the vision or vision creative thinking. These three pillars of the new strategic thinking mode allow actors to operate in conditions of direct and indirect exploration activity, creativity, systemic vision of interdependencies, guided by hypotheses subjected to verification, propensity to discover new combinations between consolidated knowledge and new cognitive inputs. In fact, in an era of strong turbulence and profound redefinition of the economic-social dynamics it is necessary to develop innovative knowledge at an individual and collective level, expanding the horizon of the analysis by developing rational imagination with hypotheses to be tested, ready to capture new signals to implement new strategies of action (Brzezinski, 1980).

2.3 – Theoretical frame at the micro level: adaptive strategic thinking

Based on the previous theoretical framework, the adoption of adaptive strategic thinking is proposed as an operational model. The complex, dynamic, uncertain, evolutionary, ubiquitous and information overload environment requires a constant commitment to the application of strategic thinking which means abandoning the orientation to the production of static plans and systematic analyzes (O'Donovan 2018) for an incessant exploration of unexplored fields of knowledge (episteme) to expand through experiments (techne) on the basis of continuous information and feedback from actors at multiple scales (mapping). It is the time of cognitive, strategic and operational flexibility that must face ubiquitous connectivity and ubiquitous computing (BCG, 2015).
In this context, *dynamic capabilities* play a crucial role both at the company and actors levels (Teece, 1994, 2017, 2019), which can be integrated with adaptive strategic thinking in particular for the connected *learning* process that evolve around three areas: (1) *Sensing*: exploring technological opportunities and evaluating their scope; (2) *Seizing*: identifying potentialities in which to invest intangible and material resources; (3) *Transforming*: introducing transformations that are congruent with the trajectories identified for the purpose of strategic adaptation.
So in this complex era (Sheng and Cheng 2017) the ability to read and interpret the signs of change, the ability to formulate and experiment explanatory hypotheses, to learn from experimentation, to elaborate action models whose effectiveness is constantly verified, are the positive nucleus of an exercise of *adaptive strategic thinking* directly connected to individual and collective learning mechanisms and processes (Lombardi 2021).
The decision-making space is nowadays organized according to internationally defined coordinates such as the 17 UN SDGs and the new Agenda for Sustainable Development (UN, 2015) that change production and consumption models. These models represent the evolutionary scenario of

current landscapes characterized by uncertainty and complexity where processes and products are characterized by being multi-technology and multi-domain knowledge, thus confirming their nature of complex processes that require mindsets and strategies that create complex problem processes solving (Fischer et al., 2012). These landscapes or contexts are well represented by the idea of smart specialization (Prieto et al., 2019), which depends on the economic, innovative and scientific potentials that must be combined and coordinated in an innovative way to respond to societal challenges. The global systemic goals (1) are achieved through the following frame: 2) the prioritization of the technical-scientific challenges for socio-economic systems; 3) the identification of micro objectives and behaviors that are consistent with the above macro ones; 4) the necessary development of multi-stakeholder project partnerships; 5) the identification of simple and multidimensional indicators for supporting the monitoring and control of processes and their outcomes.

This adaptive frame will be characterized, among others, by a careful selection of objectives, their congruence with the global parameters and with the possible cross-scale effects, and the selection of project indicators which will be both qualitative (oriented to macro goals) and quantitative (attributable to a numerical value). These simple but dynamic and multidimensional indicators will be the triggering mechanisms of creative planning and exploratory activity of unexplored spaces of knowledge according to a process of entrepreneurial discovery EDP (Marinelli e Perianez-Forte, 2017) that will set the scene for new skills. Among these, *design thinking, problem finding, problems solving, collaborations at various and transversal levels* become priorities, as the result of three critical guidelines to be followed to reconstruct the idea of work (Evans-Greenwood et al. 2017) and empower the new agents of change: (1) Problem Finding; (2) Problem solving; (3) Systems Thinking. The outcome of such new training paths will allow actors to acquire skills about developing attitudes to represent complex problems; modeling processes and outputs; realizing congruences between different cognitive domains; promoting experiments to identify problems; pursuing interactions between disciplines; developing analytical thinking.

On the basis of this conceptual and theoretical framework, in the following paragraph we present and discuss the case study of a non-profit association that has launched an innovative project for high school students to spread these new mindsets and tools through a contest of circular and innovative ideas in classroom.

3 Case study. Empowering the youth to face societal challenges of complexity and uncertainty.

The case we report here is a contest project of innovative and circular ideas for high school students which reached its fourth edition in 2022.

The contest was designed and organized by a non-profit organization whose vision is the formation of a new young leadership class with values and principles oriented towards sustainability. The mission is to promote the culture of sustainable development and business sustainability to be achieved through institutional services and training activities.

Among the institutional activities, the promotion of good corporate sustainability practices among the younger generations and the development of ad hoc projects for high school and university students.

The members of the association belong to different professional fields and backgrounds, all but united by a passion for sustainable development and the application of its principles and tools in the entrepreneurial and industrial and academic fields. On the basis of this background, also strengthened by other sustainability projects developed for other partners at the national level, such as technical and training support for the development of cooperative and profit school enterprises or the development of contents for teachers in the field of media education on sustainability, the Association decided in the 2018-19 school year to launch its own project for high schools in its territory (Tuscany, Italy). The contest is promoted and organized in collaboration with local bodies and associations including the local metropolitan incubator of startups in the pre-seed phase, the main trade association for SMEs and Artiasans, the main workers' union and the schools themselves.

The project is a real contest for the development of circular and innovative ideas in the classroom.

The project of circular ideas in the classroom was designed from the awareness, after the first events dedicated in particular to University students, to extend and involve the youngest, especially the students aged 16-18.
Among the main reasons, the possibility of linking this experience to a real professional project that offers a first contact with firms and the job market, also according to the discipline that regulates alternating school-work courses in Italy.
Specifically, the format includes three moments: the first is the World Café on Sustainable Business and Innovation, the association's annual conference in which managers and entrepreneurs from top-level national companies participate to meet young students , entrepreneurs and startup to talk about sustainability. On this occasion on site, during the course of a day, students have the opportunity to hear the projects, the challenges and opportunities of investing in sustainability from the real protagonists and to interact with them.
The second phase, totally online, includes three webinars in which the three main themes are addressed: the SDGs, the circular economy and innovation. These are presented in a mixed way of lectures, guet speakers, testimonials and exercises. At the same time, especially in the part of exercises, which link the periods between one webinar and the other (15 days), students are equipped with conceptual and operational tools such as design thinking and system thinking (business model canvas, idea development framework) in addition to important soft skills such as communication and english as foreign language.
The third phase, the hackathon day, begins after a 4-week break where students and their teachers work in the classroom to develop their ideas and report them according to the required frameworks and documents.
The final teams selected attend the hackathon day where they have the opportunity, thanks to the support of mentors from business and academia, to perfect their idea and implement their pitch. The pitch is then presented to the jury.In the last two editions among the members of the jury have also participated members of an American University that promotes a contest of entrepreneurial ideas at the global level.
At the end of the hackathon, students have another two weeks to review the pitch, based on the feedback received and send it to the jury. The winners have the opportunity to participate as auditors in the startup training program offered by the partner incubator in one of its innovative startup programs.
Over the four years, the project has registered the participation of over 500 students organized in teams who have proposed different ideas from sustainable tourism routes in pre-mountain areas at risk of impoverishment and depopulation, to the organization of anti-COVID kits and safe paths in art museums, from smart parking lots in schools and neighboring areas to reduce C02 and travel time to smart lighting in common areas such as schools to reduce costs related to electricity consumption, from the recovery of cigarette butts for the building industry to regeneration projects of corporate computers in a circular way to extend the life of products and many others.

4. Discussion

Despite the goal achieved in terms of number of participants and ideas, engaged partners, the positive feedback through qualitative queries filled by the participants, and especially content design and delivery and the quality of students' ideas that confirm the acceptance of this new frame for thinking and resolving pressing problems, still some critical areas have emerged during the four years of development of the project, here reported for future developments and discussions.

Table 1. The Adaptive Strategic Thinking Framework and t he areas covered and developed by the project

The adaptive strategic thinking framework		**The project**
Goal – Global level	**17 UN SDGs**	**Conference + webinars**
Sfide techno-scientific • *Pandemic crisis* • *Climate risk* • *Energy-environmental transition* • *Techno-economic and power asymmetry*	**Risposte / Macro goals** • *Resilient systems* • *Low carbon economy* • *Preventing and mitigating climate risk* • *Sustainable development*	Conference Webinar

• *Economic-employment crisis in the country*	• *New employment*	
Stakeholders	*Firms, local and national communities, institutions and organizations, etc.*	Hackathon, design phase by students
Tools for continuous feedback	*Design thinking, systems thinking,*	Webinars (Business Model Canvas, Idea Development Framework, Pitch)
Parameters for structured processess	*Benchmark, best practices, case studies*	Conference + Guest speakers during webinars
Indicators (multi-dimensional simple, top down and bottom up, mapping)	*Ecological footprint, CO2 emissions, new technologies, people involved/engaged, etc.*	Hackathon, design phase by students

In particular, the main critical element concerns the support to the project by local institutions and medium-large enterprises, affecting the contribution to sustainable development in terms of the SDG 17. One of the problems of bottom-up projects promoted by social enterprises and linked to the local territory is the scale of the project itself: the possibility of scaling up, accessing supports of a different qualitative-quantitative kind. Scaling up the project through partnership will create further positive social and environmental impacts. Although there has been stakeholders' interest and participation about the whole project and its single steps (conference, webinars, hackathon), recurring and recursive material support over time such as access to public or private funds or massive voluntary participation of employees from some companies (as partners or sponsors, through donation of time or indirect financial support such as scholarships or otherwise) would help the project grow and impact the local industry and job market. An offering of students trained according to the latest trends and needs of the market itself could act immediately as an agent for change. Students will be able to join effectively already existing sustainability teams or projects, which will get advantage from their innovative strategic mindset and basic operational background, or positively nurture the specialization offering of Universities, bringing fresh ideas and hands-on experience from the industry into the first years of their college education.

Conclusions.

The new era of the Great Acceleration of complexity, uncertainty and anxiety impacts the socio-economic systems and the modes of production and consumption for which the actors (entrepreneurs, policy makers or young people) must adapt to highly unpredictable and changing scenarios. For this reason their knowledge base must necessarily change, enriching the minimum dowry with new cognitive dimensions reached through a strategic and operational model that is adequate to the new situation. Adaptive strategic thinking and the relative skills discussed in the previous paragraphs are the conceptual and operational frame with which to measure new strategies. In the case of young people, future leaders, it is necessary that formal school training be offered the possibility of interact with actors playing on the frontiers of innovative change for the energy and environmental transition. For this reason, the case study here presented and discussed is a good starting point to design future sustainability training projects that could integrate formal educational school programs. Although the many challenges, one of the main reasons to develop such projects it is to contribute with young leaders to chase the information gap that already exists between productive sectors and dynamic accelerated complex and unpredictable scenarios. A gap that could increase if standardized formal education would be included into the first group without a proper support.

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