FABLAB AS A NAVIGATOR OF TOMORROW'S COMPETENCIES

Analytical Report from the "Jobs of Tomorrow" Project implemented by the Robisz.to Association at FabLab powered by Orange in cooperation with the Orange Foundation

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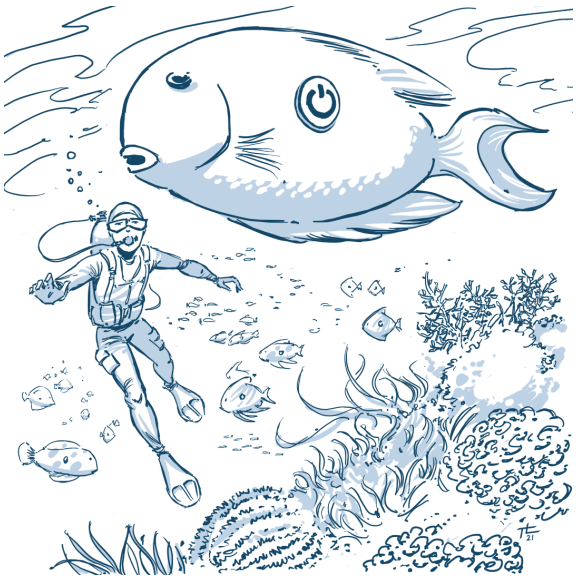
1. INTRODUCTION: FABLAB AS A “SIGNAL OF CHANGE”

This report constitutes an analysis of the “Jobs of Tomorrow” project implemented by the Robisz.to Association and funded by the Orange Foundation. It goes beyond the framework of a traditional evaluation report, adopting as its goal a strategic reflection on the role of FabLabs in the context of profound changes in the labour market. The justification for this approach lies in the scale of market challenges and the pace of technological transformation, which require not only documenting completed activities, but above all embedding them in a broader, systemic picture of the forces shaping professional reality.



The key concept used in the report is the notion of a “signal of change.” FabLab is treated here not as an ordinary venue for workshops, but as an early, still indistinct harbinger of change that may become a significant market trend. A signal is a niche phenomenon that within the current system may appear marginal, but in the context of developing trends carries transformative potential on a societal scale. Treating FabLab as a lens for socio-economic change made it possible to examine how, in the age of digital and energy transformation, one can build the resilience of local communities and develop professional competencies for which demand is only beginning to emerge.

In order to ensure the reliability and usefulness of the conclusions formulated, the analysis was embedded in a broad context of trends concerning the future of the labour market. This means that the assessment of the “Jobs of Tomorrow” project is not based solely on observation of its course, but on a systematic comparison of the activities carried out with the directions of change identified by educational and socio-economic foresight. Such an approach makes it possible to answer not only the question of what was accomplished, but above all - whether the activities carried out are adequate to the challenges facing young people entering the labour market today, as well as those seeking a new place within it.

The report consists of five parts. The first describes the research methodology applied. The second presents the identified trends shaping the future of work. The third synthesises the key implications arising from the foresight analysis conducted. The fourth formulates recommendations for programme modification. The fifth provides a summary of all findings. Explanations of key concepts used in the report are contained in the glossary at the end of the document.

2. METHODOLOGY

The analytical process employed a methodology rooted in strategic foresight. The essence of this type of reflection on the future is the abandonment of a focus on a single, implicitly most probable sequence of events and processes in favour of a broader analysis of potential possibilities, which enhances preparedness for change and the capacity for adaptation. According to American researcher Jim Dator, reflection on the future should be governed by three laws:

1. The future cannot be predicted, because the future does not exist.
2. Every useful idea about the future should seem absurd.
3. We shape the tools we use, and then those tools shape us.[1]

Based on the assumptions about multiple possible futures, a methodological process was developed that on the one hand allowed for a broad look at the implications of phenomena already observable today, and on the other was solidly grounded in the analytical process. The adopted approach encompassed: identification of key trends and areas of change, identification of potential future implications of these phenomena using futures wheels, and then a synthesis aimed at diagnosing the potentials and challenges that, in light of the experience of the "Jobs of Tomorrow" project, FabLabs may be able to address.

2.1. Identification of Trends and Areas of Change (PESTLE & Desk Research)

The first step was to identify the key areas of analysis and trends. PESTLE analysis (Political, Economic, Social, Technological, Legal, Environmental) was used to elicit them, which enabled not only the identification of key vectors of change, but also their embedding within various dimensions of social life. Five key strategic categories were distinguished:

- Forms of work: How is the model of employment and work organisation changing?
- Competencies of the future: What skills does the market need?
- New services/products: What will there be demand for in local ecosystems?
- Areas of education: How to teach in order to prepare for the unknown?
- Local community: How do social changes and technology affect the bonds and resilience of people living in the immediate environment?

These categories subsequently became the canvas upon which the analysis was designed through futures wheels.

2.2. Futures Wheels Method

The culminating moment of the analysis was the use of the futures wheels method. This is a foresight exercise based on a wheel model, in which direct implications for specific analytical categories are assigned to a phenomenon placed at the centre. Subsequently, further implications arising from the mapped implications (so-called 2nd-order implications) are assigned. In this way it is possible to capture phenomena that are not immediately obvious, which may emerge as a consequence of the central phenomenon.

For the purposes of this report, two futures wheels were created. The first concerned the future of work - the wheel was divided into sections corresponding to the five strategic categories, each of which was assigned trends concerning the labour market, and their implications were then determined. At the centre of the second wheel, FabLab was placed as a signal of change. This wheel was also divided into strategic categories, and the implications were drawn directly from the central signal.

In the next step, both wheels were overlaid, which enabled the analytical identification of areas of synergy and so-called “blind spots” - areas requiring attention. On this basis, the conclusions and recommendations contained in the subsequent sections of the report were developed. The full list of implications located on the futures wheels constitutes an annex to this document.

3. IN-DEPTH ANALYSIS OF FUTURE TRENDS

The methodology described above defines the interpretive framework for the entirety of this report. The two-stage approach - encompassing the mapping of trends in a PESTLE framework and the development of futures wheels - made it possible to conduct the analysis in a structured and comparable manner, minimising the risk of omitting significant areas of change. The first and fundamental step in this process was identifying the trends shaping the future of the labour market. These constitute the reference point for all subsequent analysis: without recognising them, a reliable assessment of the extent to which the "Jobs of Tomorrow" project responds to the needs and challenges of the future would be impossible. The section below presents the selected trends, illustrating both their diversity and their interconnections.

Trend	Description	Significance for FabLab
From automation to cobots (Industry 5.0)	Evolution from fear of automation towards a Co-Pilot Economy. Industry 5.0 places emphasis on collaborative robots (cobots), requiring supervision and emotional intelligence in interaction with machines.	FabLab can become a place where participants learn to supervise autonomous systems, learning to use and understand the operating principles of advanced machines such as plotters or CNC milling machines. This builds technological flexibility that facilitates smooth transition to new production models.
The gap in chronically deficit occupations (hybrid craftsmanship)	Market analyses raise the alarm about a structural shortage of skilled workers (incl. carpenters, joiners, locksmiths, machine operators). Those who combine their trade with knowledge of digital technology gain the highest market value.	FabLab as an accelerator of workforce for Craftsmanship 4.0. Creating the profile of the digital craftsperson - a specialist who wields a chisel just as skillfully as modern digital software.
ESG requirements and green microspecialisations (CE)	ESG standards and decarbonisation are the most powerful vectors of business change. The green transformation requires competencies in material recovery, repair, and design for a closed cycle.	FabLab as a centre of CE competencies. Transition from the theory of circularity to the physical design for recovery. An investment that fits into ESG non-financial reports.
Cybersecurity at the hardware-software interface (IoT)	The ubiquity of IoT means that physical systems are becoming vulnerable to cyberattacks. Hardware security is becoming just as critical as software security.	Introduction of hardware/IoT security modules in the electronics zone. Teaching responsible engineering and building the digital resilience of devices from the very moment of their construction.
Demographics and assistive	An ageing society and a declining labour supply are forcing the	Age Tech Incubator - a space where young makers, in collaboration with

Trend	Description	Significance for FabLab
technologies (Age Tech)	development of assistive technologies for seniors.	seniors, create hardware solutions to facilitate daily functioning. FabLab builds intergenerational solidarity.
The era of AI agents and algorithms	AI is transitioning from the stage of a simple tool to an autonomous agent. The key competency is becoming the delegation of tasks to algorithms and the physical verification of their results.	Use of generative AI to optimise physical projects. FabLab teaches the management of digital intelligence in order to achieve a concrete result in the physical world.
Skills-based hiring and micro-credentials	Employers are moving away from traditional diplomas in favour of verifiable skills. A documented portfolio and certificates confirming proficiency in specific technologies are what counts.	Implementation of a certification system for specific technical skills. FabLab shortens the path to employment.
Democratisation of production and the MaaS model	The shift from owning one's own production lines to using external production capacity on demand. Thanks to digitalisation (e.g. online platforms), small companies can commission the production of complex parts as easily as ordering a courier.	FabLab as the missing link in the hardware infrastructure for micro-entrepreneurs, freelancers, and start-ups. It trains people ready to work in the Gig Economy model.
Hyperpersonalisation and on-demand production	The use of digital technologies (such as 3D printing or AI) to create products perfectly tailored to individual customer needs, without incurring the costs of mass production. Production only begins at the moment of ordering (on-demand), eliminating the need for warehousing.	MaaS model. FabLab as a local production node for micro-entrepreneurs and hardware start-ups, radically reducing business risk.
Platformisation and the Gig Economy in the technical sector	Project-based work is becoming the norm in the environment of makers and specialists. They need access to production infrastructure available on demand, without fixed costs.	The function of a coworking workshop. Transition from the paradigm of owning tools to the paradigm of sharing resources and exchanging knowledge.
Futures Literacy and building resilience	The pace of social, political, and technological change is generating fear of the future. One of the most important competencies is becoming the ability to adapt and come to terms with uncertainty.	Building technical and competency-based agency. A participant who can repair equipment or create a prototype from scratch gains resilience to market crises. The possibility of upskilling in short cycles also

Trend	Description	Significance for FabLab
		enables agile adaptation to the needs of the changing labour market.
From large factories to local workshops	Fatigue with mass production, ecological requirements, and logistics crises are changing the production paradigm: moving away from dependence on foreign factories in favour of local workshops.	FabLab as the heart of local, distributed digital production. Builds the resilience of the local community.

The analysis of the identified trends points to three dominant axes of labour market transformation. First, the progressive hybridisation of competencies - the blurring of the boundary between physical craftsmanship and digital technology. Second, a shift from a model of ownership to a model of access, both in terms of production tools and educational pathways. Third, a growing premium on resilience - the ability to adapt and act with agency in conditions of uncertainty. It is precisely in these three areas that FabLab as a signal of change has the greatest transformative potential.

The above trend analysis constituted the key starting point for an in-depth reflection on the implications of FabLabs as a signal of change. The identified trends became the source material for the development of two futures wheels. The juxtaposition of both perspectives made it possible to identify areas of synergy and “blind spots.” The following section presents the key implications together with the analytical conclusions arising from them.

4. STRATEGIC IMPLICATIONS (Conclusions from the Futures Wheels)

The full list of implications located on the futures wheels constitutes an annex to this report. The key conclusions are presented below, broken down into five strategic categories.

A. Forms of Work

Implication	Description
Modern guilds	FabLab redefines the role of the craft guild as a place of knowledge transfer between generations, combining traditional, physical skills with digital ones. Work becomes a communal process.
Hybrid teams	Working side by side with AI agents, and in the near future also with cobots, is becoming the standard that prepares participants for a modern office and production environment.
Resource sharing	A reduced need to own tools in favour of subscription-based access to professional zones (sewing, joinery, electronics), which is in keeping with the trend of the sharing economy and the trend of hyperpersonalisation.
Safe democratisation	Structured safety procedures allow advanced machines to be made available to people without engineering qualifications, opening technology up to everyone.

⚠ Blind spot: Cannibalisation of the professional market: There is a risk that the low barrier to entry in FabLab will lead to price dumping in the design services sector, which may provoke resistance from local engineering firms.

B. Competencies of the Future

Implication	Description
STEAM hybridisation	A complete blurring of the boundaries between traditional craftsmanship and high technology. The competency of tomorrow is the ability to combine a chisel with source code.
Circular design	The competency of planning a closed product life cycle from the sketch stage - thinking about what will happen to an object in 10 years' time.
Application of Futures Literacy in everyday work	The ability to rapidly prototype and test solutions in response to changing market conditions.
Oversight of technology	The ability to critically verify and validate the results of the work of autonomous systems. This is a transition from the role of machine operator to that of controller of digital processes, who, thanks to

Implication	Description
	craft knowledge, can identify algorithmic errors and optimise their operation in the physical world.
Psychology of error and resilience	FabLab is a unique testing ground. The prototyping process teaches acceptance of failure as a natural stage of the production cycle, which is a key competency in the VUCA world.
Inclusivity and psychological safety	For FabLab to fulfil the function of an incubator, it should be a space free from judgement, where people with lower digital competencies do not feel excluded.

⚠ Blind spot: Skill atrophy: Excessive reliance on AI algorithms and automated production processes may lead to the atrophy of deep knowledge and craft sensitivity to materials.

C. New Services / Products

Implication	Description
Digital repair technician	A service for repairing and regenerating objects using reverse engineering and 3D printing (implementing the global Right to Repair trend).
Platform for green microspecialisations	Certified consulting and workshops in the field of upcycling for local companies seeking ecological solutions.
Age Tech Incubator	Creation of personalised technical aids improving the quality of life of seniors.
Agile prototyping	Services for the rapid deployment of physical products for the creative sector, bypassing lengthy and expensive industrial processes.

⚠ Blind spot: Legal liability and intellectual property: Modern MaaS models and the right to repair raise questions about legal liability for unauthorised modifications of equipment. There is a risk of infringements when printing unauthorised spare parts or modifying protected industrial designs.

D. Areas of Education

Implication	Description
Competency incubators	FabLabs support the process of smoothly acquiring unique market qualifications through the realisation of real projects (learning-by-doing). They combine learning to operate machines with the development of soft skills, such as solving complex problems and working in interdisciplinary teams.
Training of educational staff	Training a new generation of teachers who become facilitators of the creative process. Emphasis is placed on the practical use of

Implication	Description
	technology (3D printing, electronics, programming) in everyday teaching, and on developing critical thinking in students in their interactions with algorithms and machines.
Humanisation of technology	Democratisation of access to digital tools by removing entry barriers for people with a humanities or artistic profile. It consists in adapting technology to human sensibilities and needs, promoting the conviction that idea and creativity are paramount over the tool itself.

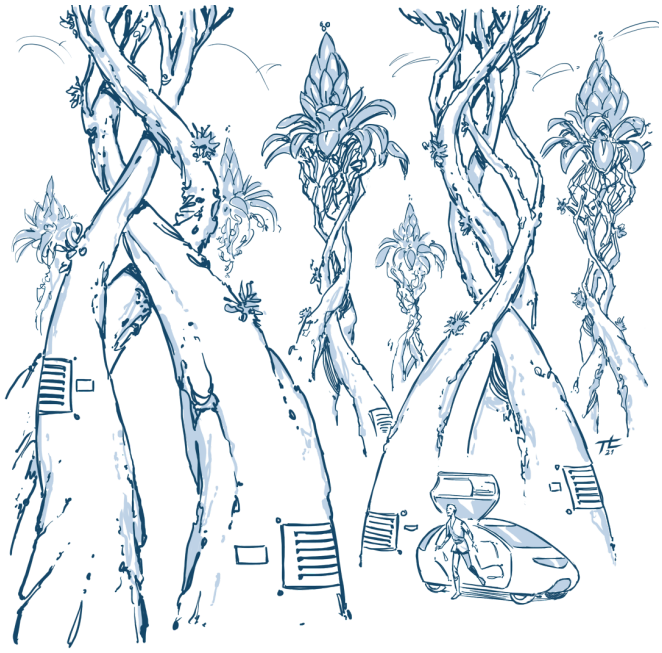
E. Local Community

Implication	Description
Reduction of exclusion	Effective vocational activation of young people through hard skills that give an immediate sense of agency and value in the market.
Urban resilience	Building a local base of tools and knowledge that allows a neighbourhood to be autonomous in terms of repairs and manufacturing in the face of global crises.
Smart city consultant	FabLab as a strategic partner of the city in designing technology that genuinely serves residents (so-called empathic technology). FabLab becomes a translator between the technocratic vision of the city and the needs of the people living in it.
FabLab as a third place	Traditional offices are losing significance, and people are looking for third places between home and work that offer a sense of agency and community. FabLab can fill this gap, combining an educational function with the function of social regeneration.

⚠ Blind spot: Local nuisance: Scaling the FabLab model within the urban fabric raises environmental challenges: noise, emission of fumes, disposal of chemical waste from 3D printing.

5. STRATEGIC EVALUATION OF THE “JOBS OF TOMORROW” PROJECT

The conclusions presented in the previous section provide a fuller picture of the relationship between what the future of the labour market requires and what the “Jobs of Tomorrow” project offers in its current form. The analysis showed that the project has solid foundations and accurately fits into some of the identified directions of change. At the same time, it revealed areas where its strengthening or modification is both possible and warranted.



The following recommendations arise directly from the foresight analysis conducted and constitute its practical translation into specific actions. They were formulated with the future editions of the project in mind and relate both to its programme content and to the methods applied, as well as to the thematic areas requiring greater emphasis. Each recommendation is rooted in the identified trends and their implications, which allows them to be treated not as arbitrary suggestions, but as a response to the real challenges facing the participants of the project.

Recommendation 1. From 3D Modelling to Algorithm Orchestration

The key recommendation is to move away from teaching traditional, time-consuming 3D modelling, which in the age of artificial intelligence is becoming a declining competency, in favour of skills in algorithm orchestration and the use of generative design. Instead of painstaking drawing of details from scratch, participants should learn to manage digital processes and critically verify the effects of AI’s work, which directly prepares them for the role of modern specialists capable of effectively collaborating with technology. Such a paradigm shift will allow FabLab to cultivate technological flexibility in young people – that is, the ability to adapt smoothly to new tools and machines without fear of automation.

Recommendation 2. The Profile of the Digital Craftsperson

We postulate a significant strengthening of areas related to chronically deficit occupations, such as joinery or the operation of advanced CNC machines, but in a modern, hybrid approach. The goal is to develop the profile of the digital craftsperson, who combines traditional knowledge of materials and manual proficiency with skilled use of engineering software. Such an approach not only addresses the pressing structural problems of the economy, but also protects against the atrophy of craft expert knowledge, giving graduates a specific trade with a very high market value and resilience to full robotisation. The introduction

of an AI in craftsmanship module will strengthen these competencies, teaching the optimisation of material usage and the automation of production processes in the spirit of Industry 5.0.

Recommendation 3. Integration of Soft Skills with Workshop Practice

The reform should encompass the pedagogical layer, replacing isolated group work workshops with full integration of soft skills with the practical process of craft mentoring. In this model, technology becomes a tool for building agency and overcoming fear of digital transformation, which is crucial especially for people with a humanities profile. A key element of education is the 'disenchantment of failure' - in FabLab, a design error ceases to be a reason for assessment and becomes a natural stage of learning and critical thinking. Such an approach allows for the parallel cultivation of technical proficiency and psychological resilience, making the workshop a safe place for the development of future competencies in a natural and engaging way.

Recommendation 4. Micro-credentials and Digital Portfolio

In order to genuinely increase the career prospects of young people, especially those from groups at risk of exclusion, traditional participation certificates should be replaced by verifiable micro-credentials and digital portfolios. Documenting the actual process of building a prototype (from concept to finished product) has greater value for today's employers than diplomas based on theoretical lectures. The implementation of these recommendations will allow FabLab to transition from the function of a technical facility to the level of a mature educational ecosystem, building social capital, supporting intergenerational solidarity, and genuinely preparing conscious citizens for the challenges of the future.

6. SUMMARY

This report indicates the need for the evolution of the “Jobs of Tomorrow” programme towards a strategic ecosystem building the resilience and agency of participants in the face of dynamic market and technological changes. The key conclusion is a move away from teaching isolated, traditional digital skills towards AI-supported processes and a renaissance of modern digital craftsmanship.

FabLab in its new guise ceases to be merely a workshop and becomes a key third place and a local link of resilience, which prepares young people to function in the Co-Pilot Economy model. By integrating advanced generative technologies with deficit manual competencies, such as joinery or CNC machine operation, the programme genuinely responds to the structural gaps in the economy, while simultaneously promoting the values of sustainable development and the circular economy.

The recommended implementation of verifiable micro-credentials and digital portfolios will not only increase the market value of graduates, especially those from groups at risk of exclusion, but will also consolidate the position of FabLab as a modern educational institution that, instead of theoretical diplomas, offers concrete agency and the ability to adapt to a rapidly changing labour market. In this way, the project becomes an authentic signal of change, building social and professional capital in the spirit of Industry 5.0, where technology serves human well-being and the strengthening of local communities in an uncertain macroeconomic environment.

The recommendations presented form a coherent set of directions for the development of the “Jobs of Tomorrow” project, derived from foresight analysis and grounded in the realities of the changing labour market. Their implementation (in whole or in stages) should contribute to increasing the adequacy, effectiveness, and long-term impact of future editions of the project. The Robisz.to Association, with its unique practical experience and developed analytical methodology, is well-positioned to play the role of leader in this transformation.

GLOSSARY

Below are explanations of key concepts used in this report. The glossary serves as a reference point for readers unfamiliar with foresight and industry terminology.

Term	Definition
Age Tech	Technological solutions designed to improve the quality of life, health, and independence of older people.
Cobot	A collaborative robot, designed for direct and safe side-by-side work with humans.
Co-Pilot Economy	An economic model in which artificial intelligence acts as a co-pilot, supporting workers in their daily tasks, increasing their productivity and creativity.
Foresight	Systematic study of the future in order to identify potential opportunities and threats, and to support today's decision-making processes.
Futures Literacy	A competency consisting in the ability to "use the future" to understand the present. It is the ability to imagine different scenarios for tomorrow, which allows for better decision-making today, building resilience to change, and seeing opportunities where others see threats.
Gig Economy	A labour market model based on short-term assignments, contracts, and freelance work, as opposed to traditional salaried employment.
Hyperpersonalisation	An advanced strategy of delivering products and content perfectly tailored to a specific user, based on data processed in real time and AI.
Futures Wheel	A method for analysing the direct and indirect consequences (first-, second-, and subsequent-order implications) of a given trend, event, or phenomenon.
MaaS	Manufacturing as a Service - a model in which production capacity is made available as a cloud service; it allows companies to commission production without owning their own factories.
Micro-credentials	Certificates confirming the acquisition of specific, narrow skills or knowledge, constituting an alternative or supplement to traditional academic diplomas.
PESTLE	A tool for analysing the macro-economic environment, examining: Political, Economic, Social, Technological, Legal, and Environmental factors.
Industry 5.0	The evolution of industry which, beyond automation (4.0), places emphasis on worker well-being, sustainable development, and close human-machine collaboration.

Term	Definition
Signal of change	An early, often singular and marginal manifestation of a new tendency or innovation, which may (but need not) become the dominant trend in the future.
Trend	A dominant and measurable direction of change in the economy, technology, or society, maintained over a longer period.
VUCA	An acronym describing the contemporary business environment as: Volatile, Uncertain, Complex, and Ambiguous.
Green microspecialisations	Very specific, narrow professional competencies related to environmental protection, decarbonisation, and the circular economy (e.g. heat pump service technician).

ANNEX

List of implications based on the application of the Futures Wheel method:

Forms of Work		
Combining digital design with manual work.	Emergence of "Digital Craftsman" specialists.	Rebirth of modern craft guilds using new technologies.
Rapid prototyping and error acceptance.	Transition to agile project management in local firms.	Increased pace of micro-scale product innovation.
Spread of project-based work (PBL).	Growth of the "freelance maker" model - individualizing products.	Democratization of production – local micro-manufactures (on-demand).
FabLab implements free/cheap projects for NGOs.	Local organizations stop commissioning professional firms.	The local market for professional creative and engineering services is damaged.

Competencies		
STEAM hybrid skills: craft + digital.	Increased sense of agency - users believe they can influence their surroundings.	"Technological flexibility" - workers are not afraid of AI/robotics.
Learning presentation and pitching.	Ability to "sell" technical concepts to non-technical audiences.	Better alignment of innovations with market and human needs.
Increased awareness of convergence.	Development of conscious citizens.	
Self-organization of workspace and schedule.	Development of high professional autonomy.	Preparation for the "Gig Economy" model.

Education		
Quick wins at the start with simple tools.	Training for technical leaders in empathy and inclusivity.	Vocational education reform - FabLabs as standard "competence incubators."
Systems thinking and product lifecycle training.	Education based on error and testing (prototyping).	Training a new generation of "learning-by-doing" teachers.

Education		
Diagnosis of strengths and collaboration.	Clash with advanced modeling and machine failures.	High frustration and abandonment of technical paths by some.
3D modeling and electronics modules.	Demand for practitioner instructors, not just theorists.	Humanization of the tech sector, attracting diverse groups.
Circular design workshops.	Introducing ecology to schools as an engineering challenge.	

Local Community		
Direct support for local NGOs through design.	Coalitions between technical creators and the social sector.	Increased resilience of local communities (local repair/production).
Open recruitment regardless of experience.	Becoming a key consultant for the city on social innovation.	Impact on "Smart City" strategies serving residents.
Access to expensive machines for everyone.	Creating safe spaces for exchange and equality.	Reduction of technological exclusion and building social capital.
	Decreased need for personal tool ownership.	Deepening inequalities if only privileged groups gain skills.
		Local "Maker Space" culture promoting minimalism and sharing.

[1] J. Dator (2019). What Futures Studies Is, and Is Not. In: Jim Dator: A Noticer in Time. Anticipation Science, vol 5. Springer, Cham. https://doi.org/10.1007/978-3-030-17387-6_1