



ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

TraceGen

MGT-408 GROUP H

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January 26, 2023

1 Motivation and Contextualization

1.1 Our Mission

The mission of TraceGen is to trace goods from their raw materials extraction to the end-use, along their entire supply chain, through a unique eternal code marker: DNA sequences. This innovation can fight and tackle counterfeit goods, especially for textiles and precious stones.

1.2 Our Motivation

A 2020 study by the European Intellectual Property Organization (EUIPO) highlighted that the global trade in counterfeits amounted to EUR 412 billion in 2019, which corresponds to 2.5% of world trade.[1] Imports into the EU of counterfeits in 2019 reached EUR 119 billion, corresponding to 5.8% of total EU imports from the rest of the world.[1] Counterfeits and frauds are threats to sustainable development and it loses out on the knowledge and innovation “spillovers”. Just in the US, they are putting 5.4 million legitimate jobs at risk.[2] Furthermore it negatively affects the environment when production is unregulated since dangerous machinery is used and toxic materials are exploited. Society is also negatively involved, putting consumers in danger and generating confusion and mistrust in the government. Moreover, most the unregulated supply chains base their manufacturing in developing countries, in which cheap unfair labour such as child labour is common. Land and population exploitation is a global issue which is doomed to increase if no action will be taken.

Overall, the negative aftermaths related to counterfeits dramatically affect the innovation-driven activities of companies that are starting to embrace sustainable solutions. These companies risk being harmed by a bad image and loss of investments and the rise of market inefficiency.[2]

TraceGen is born to take action and help companies to be transparent about their supply chain. This offer has a clear competitive advantage to other supply chain management solutions, such as chain of custody, where the flow of information is detached from the flow of real-life products, making such systems vulnerable to fraud. The proof is, in fact, provided forensically, through a simple and fast DNA test.

Our mission is also related to the 2030 UN Agenda’s 12 Sustainable Development Goals (SDG) ”Ensure sustainable consumption and Production Patterns”[3]. In particular the targets:

- ”Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle”
- ”By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature”
- ”By 2030, achieve the sustainable management and efficient use of natural resources”
- ”Support developing countries to strengthen their scientific and technological capacity to move towards more sustainable patterns of consumption and production”

1.3 Contextualization

Given our target SDG (Responsible Production and Consumption), we locate our mission in the problem-solution space [4] in the Disorientation category.

The problem (responsible production) is wicked because:

- The challenge is broad (it affects small and large companies, from different parts of the world, in different ways).
- Black market is in some countries not seen as an issue, it is instead a life-saving business for the population.
- Society might have diverging views on its utility.

Finding a solution to this problem is wicked because:

- Governments, policymakers, and producers should all cooperate, but they may have different interests.
- Solutions are often complex and difficult to implement. For example, the DNA application and the paternity test technology must be understood by the companies' technical staff.
- It is difficult to measure the impact of a solution, due to the broad scale that it applies.
- It involves changes in international trade practices, which adds to the complexity.

Therefore, to advance our mission, we pick a hybrid policy pathway, working on both the solution and the problem at the same time. We need to make sure that our mission is well-understood by our target customers (both companies and end-clients), that governments are incentivized to adopt measures for responsible production, and that our solution can result in tangible changes.

Figure 1: The position of TraceGen in the problem-solution space.

		Problem	
		Diverging views	Converging views
Solution	Diverging views	I. Disorientation	
	Converging views		

1.4 Our Service and Technology

The tracing technology is based on a solution of colloidal particles containing DNA sequences that can be easily formulated and tailored with infinite possibilities, as nature does. The colloidal solution is applicable through a spray.

The DNA markers are harmless to the environment and humans. They are highly versatile, as a distinct marker can be used for each individual producer, manufacturer, brand, lot or production step, and can be applied to all kinds of materials. It is invisible and does not change the properties of the product and is robust enough to withstand the harshest industrial processing to ensure end-to-end supply chain transparency and control.

TraceGen offers consultancy to companies on the use and application of markers and provides the right kits containing the liquid marker formulation and tools for the application. The markers are easily applied

to the raw material or to semi-finished products at any production step, following simple procedures that seamlessly integrate into the company's processes. Through the marking, materials are assigned with a unique DNA sequence. To verify materials' integrity, a quick non-destructive test can be run at any point of the production process, providing quantitative data as a "Paternity test". At the end of the production, TraceGen provides companies with a physical label to inform the end consumers about the assessed origin of the products, claiming the company's transparency.

1.5 Policies for fair global market

TraceGen can be the solution on a global scale and can be extended as a tool for policymakers, governments and international organizations to regulate the global trading of goods between States. As an example, EU countries could favour imported/exported goods labelled through DNA markers and institute an official organ to test each item before approving it to be distributed.

Alternatively, EU governments could provide incentives to businesses that use TraceGen, such as reduced tariffs or streamlined customs clearance procedures. Similarly, there could be penalties for businesses that do not use TraceGen such as fines or bans on import and export. Further details will be laid out in section 2.3. EU governments could also establish an independent body to monitor the implementation of TraceGen and ensure that it is being used in a fair and ethical manner. EU governments could work with other international organizations, such as the World Trade Organization, to promote the adoption of TraceGen as a global standard for traceability and foster new policies.

2 Initial Roadmap

The focal points which have been identified in the **planning phase** where policy has to concentrate on have been identified as:

- **Technology** Although the technology has been introduced in terms of what problems will be addressed, there is the importance of highlighting which policies are crucial for the technologies successful diffusion.
- **The economy**, this is particularly prominent as companies/investors and other stakeholders need to be pushed to use this technology to enable a sustainable supply chain. On the consumer side, this is also of high priority. Consumers have to be motivated to use this technology to promote more responsible consumption.
- **Society**, to inspire a wider adoption of our technology, and to produce lasting effects on production practices.

2.1 Technology

The technical difficulties have already been solved. The DNA spray is already set to be used. Challenges may arise in the case the demand increases unexpectedly quickly. The main challenge now is to promote the technology and convince companies and consumers to use it.

Policies needed include the action of communication and promotion among the R&D sector and administration of companies. In order to ensure the decrease of technology gaps, decision-makers should create guidelines to design technology upgrading programs. Policies should ensure that the enabling conditions

to adopt DNA technologies exist in terms of access to infrastructure, information, and external knowledge, and the removal of regulatory bottlenecks.

To make it possible, an open dialogue between a panel of tech experts and policymakers should be always active.

2.2 Economy

It is important to identify the main negative externalities which have been generated, leading to distinct market failures. The goal of TraceGen technology is to target exactly these issues, so there are many negative externalities to consider. For example, gold can be labelled with this technology to verify origin and authenticity. A negative externality which occurs in the gold market is the impact related to 'dirty gold' where gold is mined in the amazon rainforest by precious metals brokers[5]. The practices involved to extract the gold, lead to negative externalities such as deforestation and mercury poisoning as a long-term human health issues. This is an example of the tragedy of commons, as brokers are looking to maximise their economic benefit by exploiting an unregulated resource. The negative impacts are shared by all, due to deforestation, and on a larger scale related to global warming. The rain forest here is identified as a non-excludable but exhaustible good, used as a common pool resource for that region. The idea to fix this issue is to constrict and diminish the demand for this gold by TraceGen technology. Traders and consumers will be made aware of where exactly their gold is coming from. Although consumers would pay a premium for 'traced and verified' gold they would gain confidence and feel more responsible as consumers. Another example of a negative externality within TraceGen's targeted markets is the impact of cashmere wool. The main negative externalities related to the production of this fibre yarn is desertification caused by the increase of their goat herds which devastate ecosystems by overgrazing. This practice becomes ultimately harmful to all individuals as it increases the number of dust storms in cities such as Beijing as a direct result of goat over-herding[6]. As demand exceeds supply, it tends to result in producers trading planetary health for short-term profit. This market issue can be fixed by introducing a way to identify cashmere products that only involve carefully controlled agricultural practices to prevent over-herding. This can also be slowly implemented by introducing a market of permits where farmers would have to pay for each goat in their herd to abate the ecological damage expected.

To enable social aspects of innovation, the supply chain that TraceGen targets could be heavily improved by inclusive sourcing to enhance the capabilities within the supply chain. If consumers commit to only buying products which guarantee sustainable practices within the supply chain, then a large-scale transformation of agricultural practices for example could be enabled by all producers being compelled to replicate such practices. This is especially true for competitive supply chains that may experience better productivity of their workers due to the introduction of better worker treatment. Or for example, higher efficiency and cleaner mining practices that can ultimately reduce costs towards products and the environment could be introduced.

The social positive impact is at the heart of Tracegen's business model by targeting to reverse or prevent negative effects on human health, ecology and resources within supply chains. This should attract investors such as charities and private investment funds, especially those with preferences in social output. Their investment of capital funds would directly be allocated towards making positive social impacts. Although a trade-off will have to be taken into account for profits of goods traded, the social impacts are certainly of high value. For example, if TraceGen can successfully verify the authenticity of gold from socially responsible gold producers. The additional investment would go towards preserving the ecosystem of the amazonian rainforest as a result of preventing "dirty gold" mining practices. This market

would be balanced by the fact that additional investments required to enable supply chains to operate in a more environmentally friendly way would be rewarded so that they remain a competitive company with additional selling points.

2.3 Society

Society plays an important role when it comes to the success of solutions for sustainable consumption. Since the problem itself is complex, and there is no common understanding of its effects, it is necessary to take into consideration the changes in society's beliefs and behaviours, to ensure a wider adoption or inspire similar initiatives. For these changes to take place, three main actors should be involved: the companies, the government, and the consumers. We will further discuss each one of them, along with the dynamics between them.

TraceGen is a product that directly addresses **companies**. From a business perspective, it is beneficial to use TraceGen to avoid the production of counterfeited goods. Retailers could certify the authenticity of products, which becomes particularly important when the sale of luxury goods is involved. However, besides the economical gain, companies should be incentivized to use our technology for environmental and social impact, which can be achieved thanks to the ability to track the whole production chain. The label of TraceGen should imply a positive social involvement of the company in sustainable activities in the place of production. In the case of developing countries, the company should hire locals with a fair salary, enhancing the social development of the host country. One type of incentive for such practices could be subsidies from the **government**. If the company successfully manages to ensure high standards of labour, it could be rewarded. Similarly, companies should receive subsidies for sustainable production, which would be more valuable than the additional time and effort spent to introduce a new technology - and possibly slow down production. Subsidies would also allow companies to maintain lower prices in a competitive market while using more sustainable practices. Another approach, a bit more aggressive, would be for governments to sanction companies whose chain of production is unsustainable or unclear.

On the other hand, **customers** should be encouraged to pay more attention to the source of the products they use. Companies with sustainable production, as certified by TraceGen, could use it as a marketing advantage over similar alternatives. Information campaigns launched by either the companies or TraceGen could raise awareness in a non-intrusive manner. These pushes, called "nudges" have proved to be an effective way to motivate people to adopt healthier behaviours - in our case, a preference for products with sustainable supply chains.

Therefore, changing the practices of society is a matter of shared effort between the government, the companies, and the people, particularly when dealing with sustainable production, a mission that has both an unclear problem and an unclear solution.

3 Accountability

There are many ways in which governments can be held accountable for implementing the TraceGen system:

- **Transparency:** government agencies responsible for implementing TraceGen should be transparent about the process, for example about how DNA markers are produced, and assigned, who has access to the data, and how that data is used. Regular reports should be produced in order to make the public aware of the status of the project, the failures and the accomplishments, the institutions,

organizations, companies involved etc.

- Privacy protection: governments should ensure that DNA markers are used only for the legitimate purpose of traceability of goods. They should ensure that TraceGen is not used for any other purpose, such as tracking individuals.
- Compliance with national laws: governments should make sure that TraceGen complies with existing laws, such as data protection regulations.
- Data security: governments should take appropriate measures to protect the data collected through TraceGen from unauthorized access, misuse and hacking.
- Audits: governments should conduct regular audits and assessments of the TraceGen system to ensure its effectiveness and to improve it if necessary.
- Independent oversight: governments should establish an independent body to monitor the implementation of TraceGen and ensure that it is being used in a fair and ethical manner.
- Response to complaints: governments should establish a process for addressing complaints and concerns from individuals, organizations, and other stakeholders.

4 Conclusion

TraceGen will help the global transition to reach a transparent consumer goods supply chain. However, the implementation of this technology will face many challenges. Coordination between many stakeholders, such as tech experts, policymakers, managers, and customers is needed. Companies and consumers have to be sensitized, which could be demanding in areas where the black market, unregulated land occupation, and labour and resource exploitation are seen as essential and positive. Although challenging, the latter issues are part of critical global issues already addressed in the 2030 Agenda [7] and are TraceGen primary concern. Implementing this technology will require time and multiple efforts to introduce a roadmap focused on Technology, Society and the Economy. Nevertheless, TraceGen shows immense potential to be an innovation that will help reduce counterfeits and improve consumer awareness as well as the life quality of communities.

5 Author Contributions

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2. Policies for a fair global market: Roberto Minini
3. Problem and Solution space (figure): Ana-Arina Raileanu
4. Technology Roadmap: Sandy Duruz/Elena Passaretti
5. Economy Roadmap: Vincent Ben Thlija
6. Society Roadmap: Ana-Arina Raileanu
7. Accountability: Roberto Minini
8. Conclusion: Elena Passaretti/Sandy Duruz

References

- [1] E. U. I. P. Organization, “The global trade in fakes.” [Online]. Available: <https://euipo.europa.eu/ohimportal/en/web/observatory/report-on-trade-in-fakes>
- [2] D. V. Borrell, “The knockoff effect: The hidden environmental and social impact of counterfeit goods.” [Online]. Available: <https://www.mytotalretail.com/article/the-knockoff-effect-the-hidden-environmental-and-social-impact-of-counterfeit-goods/>
- [3] D. of Economic and U. Social Affairs, “Ensure sustainable consumption and production patterns.” [Online]. Available: <https://sdgs.un.org/goals/goal12>
- [4] I. Wanzenboeck, J. Wesseling, K. Frenken, M. Hekkert, and M. Weber, “A framework for mission-oriented innovation policy: Alternative pathways through the problem-solution space,” 02 2019.
- [5] “Dirty Gold: The Inner Workings of the Immensely Destructive Market for Illegally Mined Gold — crimereads.com,” <https://crimereads.com/dirty-gold-the-inner-workings-of-the-immensely-destructive-market-for-illegally-mined-gold/>, [Accessed 26-Dec-2022].
- [6] “Ethical Cashmere: Merely a Dream or Fur-fectly Possible? — sustainablejungle.com,” <https://www.sustainablejungle.com/sustainable-fashion/ethical-cashmere/>, [Accessed 26-Dec-2022].
- [7] “Transforming our world: the 2030 agenda for sustainable development — department of economic and social affairs,” <https://sdgs.un.org/2030agenda>, (Accessed on 01/26/2023).