

## The economy of Francesco and the role of artificial intelligence: a roadmap for an application of AI in refugee shelter placement

A economia de Francisco e o papel da inteligência artificial: um roteiro para aplicação da IA na alocação de abrigos para refugiados<sup>1</sup>

La economía de Francisco y el papel de la inteligencia artificial: una hoja de ruta para la aplicación de IA en la asignación de refugios para refugiados

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**Abstract:** This article explores the intersection between the Economy of Francesco (EoF), a movement advocating for a fairer and more sustainable economy, and the innovations brought by Artificial Intelligence (AI). The EoF, inspired by the principles of solidarity, inclusion, and care for the environment, seeks to rethink traditional

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economic models that often perpetuate inequalities. The study analyzes how AI can be a powerful tool to advance the objectives of this movement by providing solutions to social and environmental challenges. In this context, in the last few years, numerous global events have intensified the demand for shelter and support for refugees and displaced individuals. The article addresses the use of algorithms for optimizing the location of facilities for accommodating political, war, and environmental refugees. It concludes that, if applied consciously, AI can significantly contribute to a more solidarity-driven, inclusive, and sustainable economy, promoting a future that respects both human dignity and the planet.

**Keywords:** Economy of Francisco. Artificial Intelligence. Facility Location Problem. Refugees.

**Resumo:** Este artigo explora a interseção entre a Economia de Francisco (EoF), um movimento que defende uma economia mais justa e sustentável, e as inovações trazidas pela Inteligência Artificial (IA). A EoF, inspirada nos princípios de solidariedade, inclusão e cuidado com o meio ambiente, busca repensar modelos econômicos tradicionais que frequentemente perpetuam desigualdades. O estudo analisa como a IA pode ser uma ferramenta poderosa para avançar os objetivos desse movimento, fornecendo soluções para desafios sociais e ambientais. Nesse contexto, nos últimos anos, diversos eventos globais intensificaram a demanda por abrigo e apoio a refugiados e pessoas deslocadas. O artigo aborda o uso de algoritmos para otimizar a localização de instalações destinadas ao acolhimento de refugiados políticos, de guerra e ambientais. Conclui-se que, se aplicada de forma consciente, a IA pode contribuir significativamente para uma economia mais solidária, inclusiva e sustentável, promovendo um futuro que respeite tanto a dignidade humana quanto o planeta.

**Palavras-chave:** Economia de Francisco. Inteligência Artificial. Problema da Localização de Instalações. Refugiados.

**Resumen:** Este artículo explora la intersección entre la Economía de Francisco (EoF), un movimiento que aboga por una economía más justa y sostenible, y las innovaciones aportadas por la Inteligencia Artificial (IA). La EoF, inspirada en los principios de solidaridad, inclusión y cuidado del medio ambiente, busca replantear los modelos económicos

tradicionales que a menudo perpetúan desigualdades. El estudio analiza cómo la IA puede ser una herramienta poderosa para avanzar en los objetivos de este movimiento, proporcionando soluciones a desafíos sociales y ambientales. En este contexto, en los últimos años, numerosos eventos globales han intensificado la demanda de refugio y apoyo para refugiados y personas desplazadas. El artículo aborda el uso de algoritmos para optimizar la localización de instalaciones para acoger a refugiados políticos, de guerra y ambientales. Concluye que, si se aplica conscientemente, la IA puede contribuir significativamente a una economía más solidaria, inclusiva y sostenible, promoviendo un futuro que respete tanto la dignidad humana como el planeta.

**Palabras clave:** Economía de Francisco. Inteligencia Artificial. Problema de Localización de Instalaciones. Refugiados.

## 1. Introduction

In recent years, various global events have generated an increasing need for the accommodation of refugees and displaced persons. The island of Lampedusa, Italy, has become a symbol of the migration crisis, receiving thousands of migrants who cross the Mediterranean in search of safety. In Brazil, the floods in Rio Grande do Sul in 2024 forced many families to leave their homes, increasing the demand for temporary shelter and support. Additionally, the political and economic crisis in underdeveloped countries, such as Haiti, has led to a significant increase in refugees seeking better living conditions. These cases highlight the urgent need to develop effective solutions for the reception and integration of these vulnerable populations.

The Economy of Francesco (EoF) (ECONOMY OF FRANCESCO, 2024), an emerging movement inspired by the principles of solidarity, inclusion, and environmental respect, arises as a critical response to

contemporary economic and social challenges. This movement advocates for a profound reflection on prevailing economic models, which frequently perpetuate inequalities and overlook the needs of vulnerable populations. By emphasizing the importance of a fairer and more sustainable economy, the EoF seeks to promote a transformation that prioritizes human well-being and the protection of the planet.

In this context, Artificial Intelligence (AI) emerges as an innovative tool with the potential to catalyze this change. With its capacity to process large volumes of data and deliver efficient solutions, AI can assist in addressing complex issues, ranging from resource optimization to enhancing the quality of life for communities affected by crises (MUSLEH AL-SARTAWI et. al., 2022). This article explores the intersection between the EoF and the innovations enabled by AI, examining how these technologies can be applied to tackle urgent social and environmental problems.

One highlighted application is the use of algorithms for optimizing the location of facilities to accommodate refugees, whether they are political, war, or environmental refugees (MYERS et. al., 2024). This example illustrates how AI can facilitate the efficient allocation of resources, ensuring that individuals in vulnerable situations receive the necessary support effectively (KINCHIN & MOUGOUEI, 2022). Throughout the article, we will discuss the ethical and practical implications of implementing AI in this context, emphasizing the need for a mindful approach that aligns technology with the values of the EoF.

The remainder of the article is organized as follows: in section 2, we explore the EoF, outlining its fundamental principles and historical development, while emphasizing its call for a more just and sustainable economic model. Next, we delve into AI (section 3), discussing its key areas of application, including metaheuristics and their role in optimization. The section 4 addresses the issue of refugees, highlighting the urgent need for effective responses to the growing refugee crisis, driven by conflicts, climate change, and other factors. In section 5 we propose the roadmap of and application of an AI approach, called Metaheuristics, to deal with the issue of refugees, in a Facility Location Problem (FLP) way. Finally, in section 6, we present some final considerations, where we synthesize insights from the previous sections, proposing directions for future research and encouraging action from stakeholders to enhance the well-being of refugees and promote an inclusive economy.

## **2. The Economy of Francesco (EoF)**

The Economy of Francesco (EoF) (ECONOMY OF FRANCESCO, 2024) is a global movement aimed at promoting a more just, sustainable, and inclusive economy, grounded in values of solidarity and care for the environment. Inspired by the teachings of Saint Francesco of Assisi, the movement emphasizes the importance of treating all human beings and nature with dignity and respect. Among its fundamental principles are the promotion of social justice, the reduction of economic inequalities, environmental preservation, and the strengthening of local economies

(RUIZ & VARGAS-SILVA, 2013). The EoF advocates for an economic model that prioritizes not only profit but also collective well-being, placing the interests of communities and the planet at the forefront.

Officially launched in 2019 by Pope Francesco, the movement called upon young economists, entrepreneurs, and social leaders from around the world to reimagine the economy from a perspective that values life and the environment. The EoF emerges as a critical response to the failures of the current economic system, which often results in inequality, environmental degradation, and social exclusion. Since its inception, various conferences and gatherings have been organized to discuss and implement the principles of the EoF [1], fostering an exchange of ideas and experiences among participants.

The EoF is not merely a theory but a practical proposal aimed at transforming economic realities through concrete actions. The history of the movement is marked by the mobilization of diverse groups, including non-governmental organizations, social movements, and universities, all committed to building an economy that respects human rights and the planet's limits.

Numerous practical initiatives have emerged under the aegis of the EoF, reflecting its vision of a people- and nature-centered economy (MYERS et. al., 2024). One notable example is the establishment of solidarity economy cooperatives that promote fair labor and social inclusion. These cooperatives offer sustainable alternatives to the traditional capitalist model, allowing members to directly benefit from their work and contribute to strengthening their communities (EŞKINAT, 2015).

Another example is the development of sustainable agriculture projects that not only meet the demand for food but also preserve the environment and respect the rights of rural workers. These initiatives promote agricultural practices that avoid soil degradation and water contamination while ensuring food security (EŞKINAT, 2015).

Additionally, the EoF encourages the creation of fair trade networks that connect local producers with conscious consumers, promoting a circular economy and reducing waste. These networks enable small producers to access markets, improving their living conditions and fostering sustainable practices.

In summary, the EoF is an expanding movement that seeks to transform the way we think about and practice economics, demonstrating that it is possible to create a more just and sustainable future through concrete and collective actions.

### **3. Artificial Intelligence (AI)**

AI refers to the field of Computer Science focused on creating systems and algorithms capable of performing tasks that typically require human intelligence. This includes skills such as learning, reasoning, perception, and decision-making. AI can be divided into two main categories: weak AI, which is designed to execute specific tasks (such as virtual assistants and product recommendations), and strong AI, which has the capacity to understand, learn, and apply knowledge across a wide range of contexts. Some areas of application for AI (GUNNING, 2019; KAVITHA & ROOBINI, 2022; (SARKER, 2022) include:

1. Machine Learning (REIS et. al., 2021): Utilized to predict patterns and behaviors, as seen in recommendation systems and predictive analytics.
2. Computer Vision (CIZOTTO et. al., 2023; SANTOS et. al., 2023): Applied in facial recognition, medical imaging diagnostics, and security monitoring.
3. Natural Language Processing (NLP) (GALHARDI et. al., 2018): Used in chatbots, automated translation, and sentiment analysis.

The versatility of AI makes it a powerful tool across various sectors, including healthcare, finance, education, and, as will be discussed, in the optimization of processes and facility location (SARKER, 2022).

Within the context of AI, optimization metaheuristics are advanced approaches used to solve complex problems that cannot be easily addressed by traditional methods. These techniques are especially useful in scenarios where the search for optimal solutions is challenging due to high dimensionality or the presence of multiple objectives. Some of the most well-known metaheuristics approaches include:

- Evolutionary Computation: Based on the theory of evolution, these algorithms utilize processes such as selection, crossover, and mutation to explore the solution space (SAATCHI et. al, 2021).
- Simulated Annealing: Inspired by the metal cooling process, this method seeks to avoid local solutions by allowing the system to "escape" from optimization traps (SAATCHI et. al, 2021).
- Swarm Intelligence: Several bio-inspired algorithms, such as Ant Colony Optimization (OSTFELD & TUBALTZEV, 2008).



These techniques are widely applied in various fields, including logistics, engineering, and urban planning, where the quest for effective and efficient solutions is crucial.

FLP is a classic issue in operations research and optimization theory that seeks to determine the optimal location for facilities (such as warehouses, distribution centers, or shelters) in order to minimize costs and maximize efficiency (BOROMRIT & JAMRUS, 2023). This problem is particularly relevant in the context of forced displacement and refugee support, where the strategic placement of resources can significantly impact crisis response capabilities.

Variables to consider in the FLP include:

- Installation Costs: The cost of constructing or renting a new facility (CELIK TURKOGLU & EROL GENEVOIS, 2020).
- Transportation Costs: The costs associated with moving goods or services to end users (BOROMRIT & JAMRUS, 2023).
- Customer Demand: The quantity of services or products needed in the areas served by the facilities (BOROMRIT & JAMRUS, 2023).

Solutions to the FLP can involve the use of algorithms based on metaheuristics, allowing for the exploration of different scenarios and the identification of locations that efficiently meet the needs of the population (CELIK TURKOGLU & EROL GENEVOIS, 2020). With the application of AI and optimization techniques, it is possible not only to improve resource allocation in emergency situations but also to contribute to the development of a more solidarity-driven and sustainable economy, aligned with the principles of the EoF.

#### **4. The Issue of Refugees**

The issue of refugees is one of the most urgent and complex challenges of our time, reflecting a combination of economic, political, and environmental factors that force millions of people to leave their homes in search of safety and dignity. According to the United Nations High Commissioner for Refugees (UNHCR) (UNHCR, 2024), the number of refugees and forcibly displaced persons has reached alarming record levels in recent years, resulting in humanitarian crises that challenge the response capacities of countries and international organizations. Refugees often face a range of obstacles, including limited access to basic services, discrimination, and precarious living conditions.

The reasons for forced displacement are multifaceted. Armed conflicts, political persecution, human rights violations, and natural disasters are some of the primary causes (MYERS et. al., 2024). For instance, regions affected by civil wars or authoritarian regimes frequently produce a flow of refugees seeking asylum in neighboring or more distant countries. Additionally, the increasing frequency and intensity of environmental disasters, exacerbated by climate change, have forced entire communities to abandon their lands.

Refugees face a challenging reality in their new countries, often struggling to adapt to different cultures and navigate complex legal systems. Access to employment, education, and healthcare can be extremely limited, resulting in vulnerabilities that may persist for

generations. Furthermore, social integration is often hampered by prejudices and stigmas surrounding refugees (FELLER, 2006).

Various initiatives have been implemented to address the refugee issue, both at the national and international levels. Non-governmental organizations (NGOs), UN agencies, and governments have collaborated to provide humanitarian assistance, including shelter, food, and psychological support. Resettlement programs have also been developed to help refugees rebuild their lives in new contexts.

Moreover, the concept of "global solidarity" has been promoted as a way to engage not only host countries but also the international community in the responsibility of caring for refugees (ABIZADEH, 2005). This includes advocating for policies that aim for social and economic inclusion, as well as strengthening support networks (FELLER, 2006).

AI can play a significant role in responding to this crisis, providing innovative solutions for resource management, service optimization, and decision support. For example, AI algorithms can be used to analyze demographic data and predict needs, facilitating the strategic location of shelters and essential services. The application of optimization metaheuristics can assist in the efficient allocation of resources, ensuring that refugees receive the necessary support in a timely manner (BOROMRIT & JAMRUS, 2023).

## **5. Roadmap for an Application of AI in Refugee Shelter Placement**

In order to implement solutions for the FLP considering the problem of refugee shelter placement, a structured roadmap can guide the process.

The initial phase involves a comprehensive needs assessment and data collection to gather relevant information about refugee demographics, needs, and geographical constraints. Collaborating with NGOs and local governments will facilitate the collection of data regarding the specific requirements of refugee populations, such as shelter, healthcare, and education. Utilizing remote sensing and geographic information systems (GIS) can help analyze the spatial distribution of refugees and available resources while identifying existing facilities and assessing their capacity and suitability for shelter.

Following this, the next phase focuses on defining key variables and constraints for the FLP model tailored to refugee support. This includes establishing installation and transportation costs, as well as expected customer demand based on the gathered data. It's crucial to incorporate constraints such as legal considerations, community acceptance, and environmental factors into the model. Engaging with stakeholders will provide further insights into additional constraints that may affect location decisions.

Once the variables are established, the development of the mathematical model for the FLP and the selection of appropriate algorithms will take place. The model will specify the objective function and constraints, followed by the choice of suitable metaheuristic algorithms for solving the FLP, such as Evolutionary Algorithms, Simulated Annealing, or Swarm Intelligence. Implementing the model using simulation software or programming languages that can handle complex optimization tasks will enable effective analysis.

The subsequent phase involves conducting scenario analyses to identify optimal facility locations under various conditions. By running simulations, different potential situations can be accounted for, such as changes in refugee influx or resource availability. This analysis will allow for the optimization of facility locations based on simulation outcomes, ensuring resource allocation aligns with the needs of the refugee population and evaluating the trade-offs between cost efficiency and service accessibility.

Once optimal locations are identified, the implementation and coordination phase begins. Collaboration with local authorities and NGOs is essential to establish the chosen facilities, ensuring that the setup of shelters includes necessary services like healthcare, education, and social support. A logistics plan will be developed to facilitate the transportation of supplies and personnel to the new facilities.

Monitoring and evaluation will follow implementation, focusing on assessing the effectiveness of the established facilities and making necessary adjustments. Metrics will be established to evaluate performance, including occupancy rates, access to services, and user satisfaction. Feedback from refugees and stakeholders will be gathered to identify areas for improvement, and the FLP model and resource allocation strategies will be adapted based on real-time data and emerging needs.

Finally, the process culminates in reporting and scaling successful strategies. Documenting findings and insights from the implementation will inform future projects and policy decisions, while exploring the

potential for applying the FLP framework in other regions facing similar refugee crises. Fostering partnerships with international organizations will help share best practices and enhance global responses to forced displacement. Through this comprehensive roadmap, stakeholders can effectively address the FLP in refugee support, ultimately improving crisis response capabilities and enhancing the lives of displaced individuals.

## **6. Final Considerations**

The refugee issue is fundamentally a human rights concern that requires an integrated and compassionate approach. As forced displacements increase, it is essential for the global community to mobilize to find sustainable and humane solutions. The intersection of social initiatives, inclusive policies, and technological innovations, such as AI, may be key to improving the living conditions of refugees and promoting an economy that respects human dignity and the environment.

To advance in this direction, we suggest several avenues for future research and practical applications:

1. **Real-Time Data Analysis:** Developing a robust real-time dataset that monitors refugee flows, their needs, and the impact of interventions can help optimize resource allocation. Research focused on the collection and analysis of this data can provide valuable insights for policymakers and humanitarian organizations.
2. **AI Forecasting Models:** Investigating the use of machine learning algorithms to predict displacement patterns and identify areas of greatest

vulnerability can facilitate the creation of more effective response strategies. This includes modeling future scenarios based on socioeconomic and climatic factors.

3. Evaluation of Inclusion Policies: Conducting comparative studies on the effectiveness of refugee integration and inclusion policies in different countries can provide a solid foundation for formulating best practices. This will help understand which approaches are most effective in promoting well-being and social inclusion.

4. Innovations in Humanitarian Logistics: Research exploring new logistical solutions for delivering assistance to refugees, including the use of drones and automated delivery systems, can enhance the efficiency of humanitarian operations in challenging contexts.

We call on all stakeholders—governments, NGOs, the private sector, and civil society—to unite around the commitment to meet the needs of refugees in a dignified and respectful manner. It is essential that the voices of refugees are heard and that their experiences and perspectives are integrated into policy formulation.

Intersectoral collaboration is vital to develop solutions that not only meet immediate needs but also promote the autonomy and inclusion of refugees in the communities that host them. By investing in initiatives that combine technology, solidarity, and respect for human rights, we can build a future where everyone, regardless of their origin, has the opportunity to thrive. Together, we can transform the refugee crisis into an opportunity to foster a more just, sustainable, and humanitarian economy.

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