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A Study on Integrating Human-Centric AI with Ethics to Advance Sustainable Innovation

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ABSTRACT

In this era where Artificial Intelligence (AI) is incorporated as a part of our day to day work, there is a very indispensable need for ethical consideration in its design and implication. This study aims to identify ethical requirements towards focusing on human centric AI in the context of fostering sustainable innovation. Human Centric AI, a paradigm focuses on prioritizing the well-being and values that humans carry, creating a guiding principle for creating AI systems that serve to help and not take over which creates new opportunities for innovation. The study would delve in analyzing how effective sustainable innovation in entrepreneurship may be enhanced by the use of ethical human centric-AI. Through a series of chapters, articles and papers across diverse sectors including healthcare, energy, and urban planning, we demonstrate how this integrated approach can lead to AI-driven solutions that are both technologically advanced and ethically feasible. Our findings suggest that by prioritizing human needs, ethical considerations, and sustainability from the outset of AI development, we can increase a lot of opportunities for sustainable innovation that address complex global challenges while minimizing unintended negative consequences which is a very big concern in today's corporate world. This research also contributes to the ongoing concern on responsible AI development and offers practical guidelines for

policymakers, technologists, and business leaders seeking to harness AI for sustainable innovation and positive societal impact. Our findings suggest that integrating ethics into human-centric AI not only mitigates risks but also fosters trust, encouraging widespread adoption of AI-driven solutions for a more sustainable future and enhancing sustainable innovation, which also helps entrepreneurship. This study offers actionable insights for policymakers, businesses, and technologists aiming to balance innovation with ethical responsibility in the AI-driven age.

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Introduction

A new world of opportunities has opened up across several industries due to the quick improvements in human-centric artificial intelligence (HCAI), which is an approach to personalizing AI development to provide advanced assistance for human well-being and an advanced lifestyle and accelerate sustainable innovation. The world is currently experiencing a data-driven technological era. Organizations using AI must emphasize ethics to make sure that judgments made by the technology are in line with human values and ideals. The area of artificial intelligence (AI) has recognized the need for ethical bounds in the development and use of new AI capabilities as their significance to society grows. A variety of social, ethical, and legal concerns have been brought to light by activists and researchers from various academic disciplines in relation to the application of AI in decision-making processes. These concerns include invasions of privacy, a lack of accountability and transparency, and bias and discrimination in the corporate world. AI should not be a risk in a society that would impact businesses in a negative manner; rather, it should be ethical enough. Sustainable innovation is the only option to remain competitive in the markets, despite the fact that many businesses are afraid of the change and the need to offer more sustainable products. Sustainable innovation is the approach of creating and introducing new goods, services, technology, or business models that benefit the economy, society, and environment by making it more of a Collaborative reliance method that builds the brands of new companies and helps them draw in new clients. Innovative solutions for sustainability, sustainable business people frequently attend to the unfulfilled needs of a wider range of stakeholders. Ecopreneurship, social entrepreneurship, sustainable entrepreneurship, and, indirectly, institutional entrepreneurship are some of the thinking and

literary streams that have explored the connection between entrepreneurship and sustainable development. When it comes to sustainable innovation, sustainable entrepreneurship comes into play. It is defined by certain essential elements of entrepreneurial activities that are less focused on technical procedures or management systems and more on the individual initiative and skills of the entrepreneurial person or team to achieve large-scale market success and societal change through environmental or social innovations. Adopting sustainable innovation is a fantastic method to improve brand perception while making a significant beneficial impact on society. Businesses that find solutions to environmental and social issues in their core operations, provide superior products that are socially and environmentally responsible, and have a significant impact on the mass market and society through their innovations are the ones that make the biggest contributions to the sustainable development of an economy and society. An important factor for AI's future is sustainability. Sustainable AI aims to reduce its negative effects on the environment and support sustainable business practices in a variety of industries. The ethical consideration of utilizing the technology and focusing on maintenance of individualism while promoting innovation, automation, and collective environmental responsibilities. The confluence of AI and sustainability highlights the many ways in which companies can leverage their systems to deliver new products and services that address consumers, employees, and investors' values. Through incorporating sustainability in to their complex watch processes, brands can further work towards the larger vision of sustainable development and continue building on brand reputation at scale. Additionally, it is essential to provide openness and include a variety of stakeholders in the creation and implementation of AI systems in order to address any biases and discriminatory outcomes, as well as to foster trust and responsibility. In order to promote sustainable innovation, the research would therefore offer integration of human-centric AI with ethics. A balanced approach to technology and a greater ethical awareness of human values and needs are necessary for the road towards human-centric AI, which is a collaborative effort. We can use human centric AI to improve and level up opportunities for everyone if we prioritize ethical issues, encourage sustainable methods, and match AI projects with global development objectives. Establishing human-centric AI strategies can help companies advance in this digital era and progress toward a more sustainable and inventive future by promoting meaningful and moral relationships.

Literature Review

The concept of human-centered AI highlights the significance of interdisciplinary cooperation in developing inclusive AI systems that tackle prejudices and encourage responsibility. Furthermore, AI

technologies are being used more and more to address social concerns and promote the Sustainable Development Goals (SDGs). China is beginning to overtake the United States as the world leader in AI research output. Developing accountability and trust in AI requires an understanding of its decision-making processes. The concept emphasizes the need of multidisciplinary collaboration and the need to confront biases while promoting responsibility. Neethirajan (2023) emphasizes the significance of moral issues and trust in AI adoption, advocating for a farmer-centric strategy integrating AI and sensor technology in agriculture. AI's functions include behavior analysis, health monitoring, and welfare prediction.It advocates for using AI and sensor technologies in cattle production using a farmer-centric approach. draws attention to how technology and ethical issues must work together. This technique considers a range of animal welfare metrics, such as physiological, behavioral, and health-related factors. Lepri *et al.* (2021) stress the integration of local and global machine learning models with the goal of advancing an ethical, transparent, and responsible Human-centric AI paradigm. The strive to develop human capabilities with that of AI, as well a creating ethical and transparent intelligent systems still goes on. These are the essence of our present model. One key contributing factor that determines whether people judge the algorithm to be fair lies in their perceptions about explainability, as revealed by their research. An important factor affecting how people perceive algorithmic fairness is the link between explainability and fairness has been emphasized.

Industry 5.0's incorporation of human-centered artificial intelligence (HCAI) is transforming a number of industries, with an emphasis on ethical and sustainable innovation. The important domains focused in this paper is Product personalization and supply chain optimization and also Integration of 5G and other supporting technologies.The significance of HCAI in enhancing worker well-being, sustainable manufacturing processes, and resolving social issues in line with the Sustainable Development Goals is highlighted by studies by Martini *et al.* (2024) and Mhlanga (2022).

Putri *et al*. (2023) and Pastor-Escuredo *et al*. (2022) have emphasized the importance of AI in promoting sustainable innovation across industries. These studies highlight the importance of designing AI with cultural sensitivity and ethical principles in mind, especially in urban environments. The complexity of digitalization cannot be adequately addressed by current ethical frameworks and provide a novel solution that places an emphasis on practical guidelines, group intelligence, and the integration of technology for the good of society. However, AI and sustainable development objectives can never come together without extensive ontology-driven ethical norms. According to Putri *et al*., operational excellence, ethical issues, and cultural factors are crucial for achieving AI's transformational potential in

the domains of healthcare, education, and environmental preservation. Advocates of an approach based on these principles believe that values such as transparency, fairness, and collective intelligence could help to ensure the ethical use of digital technology in delivering healthy cities. The literature also emphasizes how crucial it is to use empirical evidence and philosophical reasoning to develop workable solutions that improve society's well-being while reducing the negative impacts of fast digitization. A new approach is put forth by Pastor-Escuredo *et al*. that stresses useful rules, group intelligence, and technology integration for the good of society. Three hybrid approaches are proposed by Raisch *et al*. (2024) in their discussion of the integration of artificial and human intelligence in problem-solving. separate and independent search, sequential search, and interactive search. While exploratory activities, such as solving novel challenges, are more complicated and call for a hybrid approach that blends AI and human intelligence, routine work may be automated. This method improves the traditional human-centric viewpoint of behavioral theory while broadening the breadth of organizational search results. According to Morales *et al.* (2024), the sociocultural connections underlying industrial transitions emphasize the need to comprehend how individuals react as a group to socioeconomically disruptive developments. brought about by Industry 5.0. They emphasize the importance of evaluating both planned and unexpected consequences of these transitions within complex adaptive social structures.

Armstrong *et al*. (2024) have highlighted the need for soft skill development in the shift to Industry 5.0. Studies by scientists, policy initiatives, and practitioner reports all show how much demand there is for these abilities. Researchers examine the origins and history of the phrase, which highlights some intrinsic difficulties in defining, identifying, and assessing soft talents. They then use an example of soft skill training from their own work to show how these may be accepted and even encouraged. Employers are indicating more and more that they want candidates to have soft skills, as evidenced by significant practitioner reports, policy initiatives, and scientific studies that highlight the importance of these abilities. Soft talents have the potential to improve both social and individual well-being, but they can be difficult to define, identify, and evaluate. In their examination of the phrase "soft skills," the writers draw attention to inherent challenges in both their definition and evaluation. By using Estonia's approach as a case study, Paes (2023) The study underlines the need for AI tools that also respect individual rights, democracy, and the rule of law while being beneficial to society as a whole. By structuring AI in government centrally, Estonia created a unique path that allows for innovation while also ensuring agency-wide governance. According to Fofano *et al.* (2022) is promoting the use of AI and supporting national AI programs to drive economic as well as societal benefits. Their research shows that although

national policies in Europe involve financial investments in AI for social good, the continent's commitment to ethical and sustainable AI innovation may be reinforced by other, frequently disregarded initiatives. Their contribution consists of three parts: (i) A conceptualization of artificial intelligence (AI) for social good that emphasizes the importance of AI policy, particularly that proposed by the European Commission (EC); (ii) A qualitative examination of fifteen European national strategies that map investment plans and provide recommendations on how they relate to the social good. (iii) a reflection on the state of investments in AI that benefits society and recommendations for future action. The study by Howe Yuan Zhu *et al* (2024) explores the possibilities of a brain-computer interface-enabled human-centric metaverse. The study emphasizes how crucial human-centered AI is to building a metaverse that lets people engage with and control the virtual environment they live in.

Obrenovic *et al.* (2024) examine the advent of generative AI and its consequences for human-robot interaction (HRI), stressing the resulting ethical, commercial, societal, and legal challenges. Humans are characterized by their high language skills, logical empathy, personification inclination, and capacity to imitate human behavior. These models create new ethical and philosophical conundrums by obfuscating the distinctions between people and machines. The study highlights how important it is to optimize AI in a number of industries, including healthcare, entertainment, and education. According to their scientometric analysis, because generative AIs like ChatGPT can replicate human behavior and have extensive language capabilities, they will likely become increasingly popular alongside humans. In his discussion of the shift from Industry 4.0 to Industry 5.0, Spohrer (2024) emphasizes the necessity of achieving optimistic results as well as the possible importance of digital twins and AI upskilling. Raising the bar for language and communication in human civilization is the task of Industry 5.0. The shift to Industry 5.0 is linked to issues raised by the service science community because of the desire to achieve win-win outcomes wherever possible. This change broadens beyond solely technical and commercial ambitions to heighten the emphasis on environmental and social goals for a more sustainable physical infrastructure. According to Grybauskas (2024), the idea of artificial semi-general intelligence offers both opportunities and problems for businesses and societies. It offers previously unheard-of digital cognitive skills that could have positive or negative repercussions on society. The development of digital twins (DTs) and their human-centered applications in many industries are examined by Peruzzini *et al.* (2023), who highlight the importance of a transdisciplinary approach. DTs may create instantaneous connections between the real and virtual worlds and reproduce physical objects at any point in their existence, allowing for remote control and monitoring of physical objects.

Any living thing or non-living thing, including people, machines, robots, automobiles, buildings, plants, food, and the economy, can be considered a physical item. They include noteworthy examples of applications in business, healthcare, economics, and society and lay out the conditions for a human-centric approach in the design and development of DTs. With the goal of creating more moral and human-centered applications for intelligent machines, Fenwick *et al.* (2023) offer a three-level paradigm (macro, meso, and micro) for humanizing AI to improve human skills and experiences. According to their research, humanizing AI will increase the effectiveness of intelligent devices while also fostering the creation of more moral applications. This study offers a three-level (macro, meso, and micro) paradigm for humanizing AI in order to improve human characteristics and experiences. It makes the case that humanizing AI will contribute to the development of more ethical and human-centered applications for intelligent machines in addition to making them more efficient.

They cover topics such as innovation and sustainable enterprise. Gimenez-Jimenez *et al.* (2024) specifically explores solidarity and environmental attitudes in the college students' sights or plans to conduct a green business pertaining to how cultural context underpins their intentions. Dossa *et al*. (2013) introduces the idea of positive ethical networks (PENs), which form in reaction to external crises, and discuss the process of sustainable innovations in finance through the lenses of microfinance as well as social responsible investment movements. Positive ethical networks (PENs), which are created in reaction to external crises to produce sustainable ideas, are what distinguish these two movements from one another. Ghobakhloo *et al.* (2021) use an interpretive Structural Model (ISM) and MICMAC analysis to investigate the relationships between Industry 4.0 and sustainable innovation, identifying important elements like value chain integration, advanced manufacturing competency, and product life-cycle management capability. This research, based on a rigorous literature review process that narrowed down 346 initial documents to 70 eligible articles, identified the main components of Industry 4.0's contribution to sustainable innovation. Product Life-Cycle Management Capability (PLMC) emerges as a vital function, integrating data from all product life stages to optimize design, forecasting, and resource consumption. The interconnectedness of ethical issues, sustainable development, and technological breakthroughs in influencing the direction of industries and communities is highlighted by all of these research taken together.

This thorough analysis emphasizes how crucial human-centered AI is becoming to solving sustainability issues in a variety of fields. We can use AI to build a more sustainable and just future if we make sure that these technologies are developed and applied in an ethical and responsible manner.

Research Objective

1. To identify ethical requirements towards focusing on human centric AI in the context of fostering sustainable innovation
2. Analyzing how effective sustainable innovation in entrepreneurship may be enhanced by the use of ethical human-centric AI

Research Methodology

This study involves a qualitative and exploratory approach to investigate the integration of human-centric AI with ethics in advancing sustainable innovation, drawing from interdisciplinary fields such as artificial intelligence, ethics, sustainability, and innovation studies. The research primarily relies on secondary data sources, including academic literature ie. peer-reviewed articles and conference papers, industry reports, white papers, policy documents from governmental and non-governmental organizations, and case studies of AI implementation across various sectors. Data collection methods involve a systematic literature review of relevant academic databases using predefined search terms, document analysis of industry reports and policy documents, and comparative analysis of ethical AI implementation approaches across different organizations and regions. The collected data is analyzed using case study analysis to examine real-world examples of human-centric AI implementation and their impact on sustainable innovation, thematic analysis to identify recurring themes and patterns related to ethical considerations and human-centric design principles, and framework analysis to assess existing ethical guidelines for AI and their applicability to sustainable innovation contexts.

Results and Discussions

Establishing and implementing AI systems in ways that benefit and serve mankind is the goal of a human-centered AI approach. On the other hand, ethics ought to play a significant role in the future of human-centric AI, which will eventually support sustainable innovation. In essence, human-centric AI is concerned with developing AI systems that prioritize human needs, values, and ethical issues. However, the process of creating and executing new goods, services, technologies, or company models that benefit the environment, society, and economy is known as sustainable innovation. This strategy can therefore result in technologies that prioritize human needs and ideals while addressing environmental and social issues.

AI frameworks and models with a human focus

It is beginning to be clear that we are at the threshold of a new era where human-centric AI technology, with a lot of opportunities and advantages (more on this later) as well. Since technology itself has raised many ethical issues, the moral framework must remain strong enough to steer its creation and deployment. We must emphasize the enterprise models or initiatives to ensure more responsible and accountable AI systems. AI does not make any regulation of the world but it treads on to expanded webbed and tangled global regulatory environs for businesses. The IBM approach to AI ethics is the best of both Responsible and Cutting Edge, ensuring everyone has access to trustworthy AI. Ensuring stringent data protection measures and user privacy policy Data minimization respects users by allowing them to have control of their data. Let's go on to the EU approach, ensuring that AI serves humans and respects basic rights. The strategy for AI of the EU includes encouraging use throughout the economy, preparing society for socio-economic changes, and supporting industrial/ technical capabilities copyright by Industrial Leaders-Image supplied. The European Union has released a set (+49 other tech companies) of guidelines that are non-binding. Besides, this entire policy approach by the EU has been dubbed as human friendly AI in technical jargon. Microsoft came out with a type for ethical AI. It provides a model for ethical AI development grounded in six principles: accountability, transparency, privacy and security fairness; and reliability/safety. Google has an entire interdisciplinary team that explores the human element of AI: People + AI Research (PAIR) combining basic research and tooling, design framework production, working with teams across Google. Instead, it takes on the diverse forms of those communities affected and are spearheaded by all kinds — activists, artists, legislators and residents.

Ethics with human centric AI

Human-centric AI also means fostering a collaborative environment where people and AI work together for the good of all. It will put a lot of emphasis in using AI ethically and creating openness, thus trust in online conversations. These are just a couple of use-cases to successfully deploy business-friendly models using human-centric AI. Instead of completely replacing people, human-centered AI seeks to improve our capacities using clever, creative Human-centered AI leverages our cognitive capacities and enables our concepts to scale to meet far more extensive data requirements. AI is meant to assist people, but it can only do so much without human input and comprehension, knowledgeable technology. Developers and product designers can use human-centered AI to apply behavioral science principles to

technology. This allows them to access user behavior and subconscious patterns to create products and services that provide more fulfilling, educational, enriching, and, in the case of entities including the social media platform Instagram or games, in an addictive manner rewarding user experiences. In essence, human-centric AI is based on safeguarding user privacy. It is up to the policy, so that users may get back into his/her data and retain as little collected encrypted securely. Respecting ethical and privacy guidelines RESTful The principle of always maintaining user and AI system confidence. We are starting to see an increasingly widespread application of AI across the different facets of human life such as work, education and healthcare or crime. These systems must be developed and used ethically in order to prevent damage and provide societal benefits. It has been determined from the literature that there are several ethical issues that affect AI that are focused on humans. So it's very essential to incorporate human values, openness, responsibility, and trust with the human-centric AI.

Sustainable innovation

The creation and use of novel goods, procedures, or services that benefit society, the environment, and the economy is referred to as sustainable innovation. In an effort to remain competitive in their markets, businesses design their structures to support or maintain continuous innovation. In the meantime, sustainable innovation would be improved to increase future efficiency, and these two areas work hand in hand since human-centric AI improves human well-being and prioritizes users. On the other hand, safeguarding human welfare is crucial, and ethics are crucial in this regard.

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Sustainable innovation and human-centric AI are increasingly intertwined as we face global challenges like climate change and resource scarcity. By indulging into AI technologies that are designed with human needs and values at their core, we can accelerate the development of sustainable solutions across various sectors. Human-centric AI can enhance decision-making processes in sustainable innovation by providing data-driven insights while considering the complex interplay of human factors and environmental impacts. As we progress, it's essential to foster a collaborative ecosystem where

policymakers, researchers, and industry leaders work together to create a framework that promotes responsible AI development and sustainable practices, ultimately leading to innovations that are both technologically advanced and ethically sound. This approach not only drives economic growth but also ensures that technological advancements align with long-term environmental and social goals.

Even though data and facts are not widely available, several ethical requirements that support human-centric artificial intelligence in promoting sustainable innovation have been discovered from a variety of literature and case studies. A framework has been developed that can be improved and implemented in the case of ethical human-centric AI in fostering sustainable innovation.

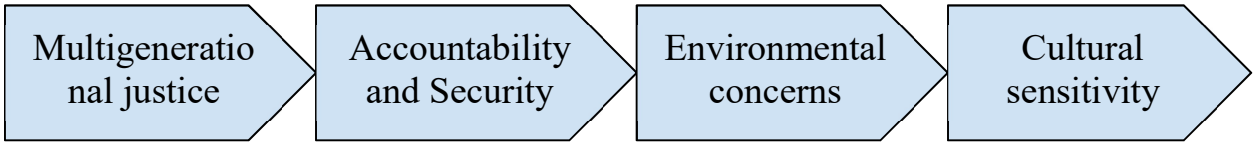

Figure 1

These are a few of the ethical standards that provide difficulties for sustainable innovation and human-centric AI. These are important conditions that must be studied and used in this emerging field in order to develop human-centric AI technology that is ethical and will contribute to innovative, sustainable change.

Significant changes have been brought about in a number of fields by the quick development of technology. Artificial Intelligence (AI) is one of the most revolutionary of these technical developments. When discussing sustainable innovation, the potential positive economic, societal and environmental long-term effects of generative AI progress arise. Our thorough literature review revealed that sustainable innovation is a growing field, and would add that ethical human-centric AI can enhance successful sustainable innovation in entrepreneurship and yield substantial benefits in a number of areas. This difficulty arises for sustainable entrepreneurs anytime they attempt to use commercial operations to spread new solutions to sustainability issues and whenever they strive for significant market shares and sociopolitical impact (Freund, 2019). We then did a deeper part of our research to find that entrepreneurs have strong data and fact based decision making habits, however it does not come back for sustainable innovation because if they could get through any well informed choice-making justifying with profitable/good business practices. Furthermore, the AI would help these businesses in synchronizing their SPEAK goals with sustainability.AI that is focused on people would also aid in the creation of

various items and speed up the creative design of those that are sustainable. Through various literature and case studies we also found that in addition to cutting operating expenses, the AI system improves supply chains to eliminate waste and enhance energy efficiency, which directly helps to sustainability goals. Cutting down on waste and surplus inventory, AI helps companies forecast demand, which helps them make better use of their resources. Business owners will claim that they only need to feed AI raw data at the moment and decide not to consider sustainability for more than five years. AI has the potential to promote relationships between investors, entrepreneurs, and other stakeholders who are interested in sustainable innovation. The result is ecosystems where individuals can come together to collaborate with one another; AI-powered platforms that share success stories and best practices that may help them understand what works. Enter ethical AI, powered by a technology that can build sustainable business models — which will be palatable to every person on the planet -— ensuring companies are not destroyed while extending themselves further across land and seas. What is ethical AI, individual behavior that creates more side communication with the consumers and hence community engagement in sustainable policies. With the use of moral, human-centered AI, entrepreneurs may speed up sustainable innovations that result in expanding companies as well as beneficial social and environmental effects. This kind of approach is founded on what we have called and characterized as holistic innovation, where environmental or ethical issues are included into them naturally and should be implemented.

Conclusion

Human-centric AI combined with ethics to promote sustainable innovation will significantly change how an organization approaches innovation, sustainability, and technical developments.

This study has provided insight on the crucial nexus between ethics, sustainable innovation, and human-centric artificial intelligence (AI), indicating substantial prospects for enhancing societal and environmental problems. Due to significant technical advancements and complexity in various industries, human-centric AI combined with ethics and sustainable innovation is becoming increasingly important for improved growth. Our findings highlight how AI systems that prioritize human needs, values, and ethical considerations can significantly improve sustainable innovation across a range of industries. It provides useful advice to stakeholders who want to use AI to drive innovation that is sustainable and has a positive social impact. The importance of this work is really to be a reminder that human-centric AI needs not only to be tech, but it has also got to permeate through organizational

culture and ethics as part of their core mission. Businesses which value the human in their AI systems and endeavor to practice such considerations with ethical diligence– are going to be at a better vantage point when connecting-those-technological-dots on what is affecting how business will look into the future. Thus, the literature purports that sustainable entrepreneurs are those who extract value from statistically-based insights to guide their decision choices whilst exercising an awareness of -the ethical elements involved in- performing such actions. Due to its exploratory nature, entailing subjectiveness and lack of external validity as well limited opportunities for generalizing or quantifying the impact on sustainable innovation it has not been possible nor aimed in this study which means that only compared with other studies based solely off a literature review at a smaller scale this may be partial evidence also because new advancements are today but current might already no longer truly reflect all cutting-edge issues. Future research should focus on quantitative analyses and diverse cultural contexts to further explore the global applicability of the proposed frameworks. Ultimately, the integration of human-centric AI with strong ethical foundations presents a promising path towards advancing sustainable innovation, emphasizing the crucial role of human values and ethical considerations in shaping a future where technology serves as a powerful tool for positive global change.

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