

# Artificial intelligence – accelerator for sustainable development in universities

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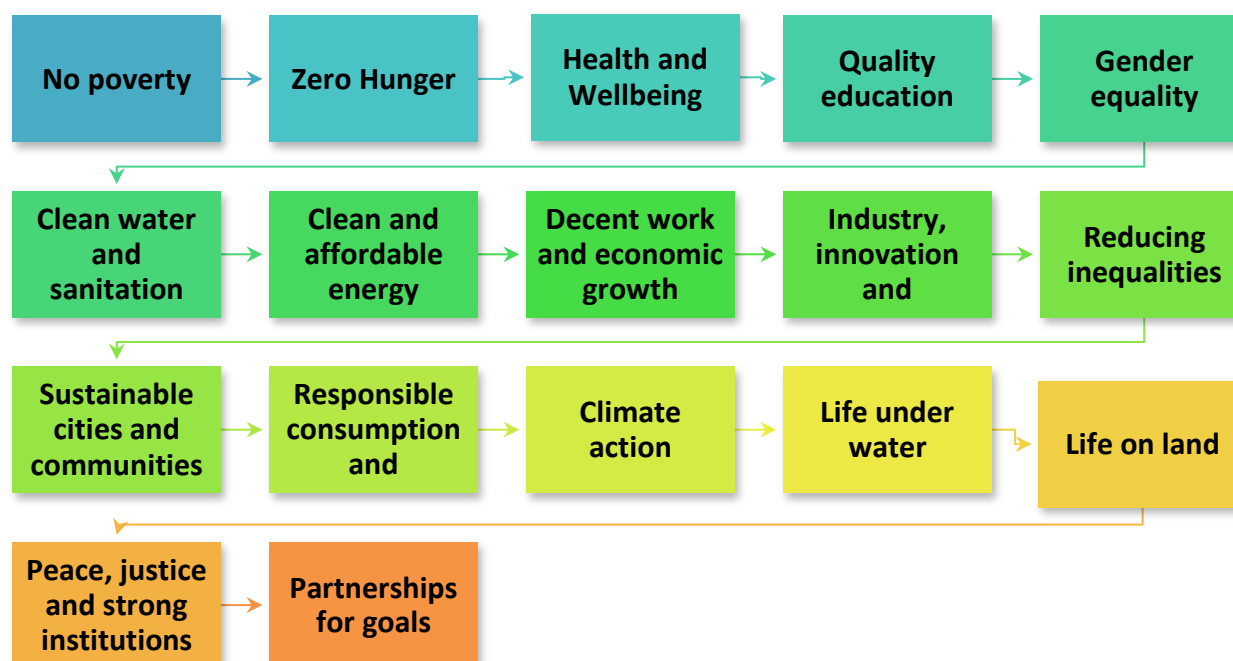
**Abstract.** *Sustainable development represents a general idea that aims to meet the needs of current generations without compromising the ability and needs of future generations. The sustainability in universities is an important concept in the current context of global challenges related to climate change, limited resources and sustainable development. These involve embedding sustainability principles in education, research, and the involvement of the university community. By adopting this concept of sustainability in universities, we can support the environment, providing a solid platform for educating the current generation, as well as the next generation, which will contribute to a fair future. Artificial intelligence has a key role in promoting sustainability in universities by supporting institutions in reducing their impact on the environment by optimizing resources and focusing on student education in a sustainable way. Artificial intelligence can help transform universities into sustainable entities in several ways such as waste management, sustainable transportation and optimization of energy consumption. The present paper conducts fundamental research using "Research Horizon Navigation"- Clarivate, analyzing 79 topics on sustainable development in universities that were published between 2019-2024. This research highlights the complex connections between artificial intelligence, university sustainability initiatives and perspectives on a sustainable future.*

**Keywords:** students, research, teaching staff, technology, sustainable development, smart campuses

## Introduction

Sustainability is the concept that designates the ability to meet the needs of the present without compromising the chance of future generations meeting their own needs. It includes a balanced approach between economic, environmental and social aspects to encourage sustainable development (Cioca et al., 2019; Global University Network for Innovation, 2019a).

For a good understanding of what sustainability means, we can consider the definition provided by the United Nations: "development that meets the needs of the present without compromising the ability of future generations to meet their own needs"(Church, 1997; Global University Network for Innovation, 2019a; Tăucean et al., 2019). In 2015, 17 Sustainable Development Goals (SDGs), also known as the 2030 Agenda, were adopted, Figure 1. They represent the global plan to ensure prosperity, well-being and environmental protection until 2033 (Church, 1997; Global University Network for Innovation, 2019a).



**Figure 1. The 17 objectives adopted**

Source: Authors' own research.

These objectives are interdependent, and their implementation requires good collaboration between governments, the private sector, international organizations and civil society (Church, 1997; Global University Network for Innovation, 2019a). Artificial intelligence has an important role in promoting sustainability in universities by supporting institutions in reducing their impact on the environment by optimizing resources and focusing on student education in a sustainable way. Artificial intelligence can help transform universities into sustainable entities in various ways such as waste management, sustainable transport and optimization of energy consumption (Church, 1997).

## Literature review

In 1987, the World Commission on Environment and Development was chaired by Gro Harlem BRUNDTLAND and published in the report "Our Common Future" the launch of the concept of sustainable development (2). In 1987, Madame Brundtland, from Norway spoke for the first time to the United Nations about sustainable development and used an Anglo-Saxon term "sustainable development". Currently, the notion of corporate social development is used (Global University Network for Innovation, 2019a; Ramírez & Sierra, 2022).

Making good choices to help the environment seems like a complicated but also complex task. But there are a multitude of small, simple things that can be done to make a positive impact. Therefore, this concept is based on the 3 Rs: reduce, reuse and recycle (Commission Européenne, 2002). The three R's of recycling are a set of sustainable practices designed to minimize the impact of people and economic activities on the environment. Implementing the 3R concept can help protect the environment, conserve natural resources and reduce waste (Ramírez & Sierra, 2022). The word reduction refers to reducing the amount of waste produced daily. This is the most effective of the 3Rs because it prevents the waste problem before the entire process begins. There

are several ways to reduce waste such as: choosing products with minimal or reusable packaging by buying in bulk when possible and avoiding products with multiple packaging; the use of sustainable and non-disposable products, as well as the replacement of disposable items with reusable options (Church, 1997). The word reuse requires the repeated use of a product or its parts for the same purpose or for a new purpose, without processing it. This approach extends the life of products and reduces the need for new items such as raw materials, materials, consumables, equipment or accessories (Church, 1997; Commission européenne, 2002). The word recycling starts with the identification and sorting of waste. It is essential to understand the types of waste, but also to sort them accordingly. Each type of material, be it paper, metal, plastic or electronic waste, has a specific recycling process. For example, paper and cardboard are recycled differently than plastic or metal. An important step in the recycling process is the cleaning and preparation of the waste (Church, 1997; Commission européenne, 2002).

Together, the 3Rs represent the key to efficiency throughout the logistics chain of ecological activities, in the sphere of sustainability and sustainable development (Zaman, 2006). In Europe over 74.5% of the population lives in cities with internet access and a great desire to purchase any product from any corner of the world. By choosing from a wide range of products, one can pay easily, safely and quickly, anytime and anywhere. Artificial intelligence has an important impact on sustainability, contributing to an accelerated transformation through administrative and operational optimization through the improvement of the learning process, consistent support in research as well as the involvement of the university community through collaboration platforms (Zaman, 2006).

## Methodology

The present paper conducts fundamental research using "Research Horizon Navigation"- Clarivate, analyzing 79 topics on sustainable development in universities regarding artificial intelligence, which were published between 2019-2024. This research highlights the complex connections between artificial intelligence, university sustainability initiatives and perspectives on a sustainable future.

These articles were selected based on an essential criterion of containing terms such as "sustainable university, artificial intelligence or education" in this research effort we encountered 79 important topics published between 2019 and 2024, identified in the Google Scholar database. In order to achieve the proposed goal, research was carried out to provide a detailed analysis, both from a quantitative and qualitative perspective, of the results obtained. The research was carried out in two stages. In the first stage, information was collected from the Google Scholar database, using "Research Horizon Navigation"- Clarivate, identifying a series of 79 topics in the field of sustainable development in universities regarding artificial intelligence, published between 2019 and 2024, and in the 2nd stage a qualitative analysis of the previously obtained results was carried out.

The present work aims to answer the following questions:

1. Can technological change be resisted by traditionalist teachers or students?
2. Can AI algorithms improve curriculum to individual student needs, helping academic performance and reducing dropout rates?

### 3. Results and Discussion

In this century of education, digital transformation is a main pawn in prioritizing sustainable management by adapting to the changes imposed by new technologies. Global research on this topic was analyzed, and following this research, the results showed data about the scientific productivity of the authors, institutions, or countries that contributed to the development of this research study. In recent years from 2019 to date, research shows major growth regarding digital transformation in the education century. The most common categories are environmental and social sciences (Cassingena-Harper, 2013; Shahzad et al., 2024).

#### 3.1 AI as an accelerator for sustainable development

Sustainability among universities is a very important topic, and the use of artificial intelligence can have a great impact in achieving this goal. Implementing technology in the educational, administrative and research process can help higher education institutions become more efficient. This digital transformation in the entire teaching process is supported and guided by the use of technological, human, organizational and pedagogical drivers in an intelligent way. Education 4.0 aims to help students and teachers with social skills in mitigating climate causes and effects based on people's awareness, Figure 2.

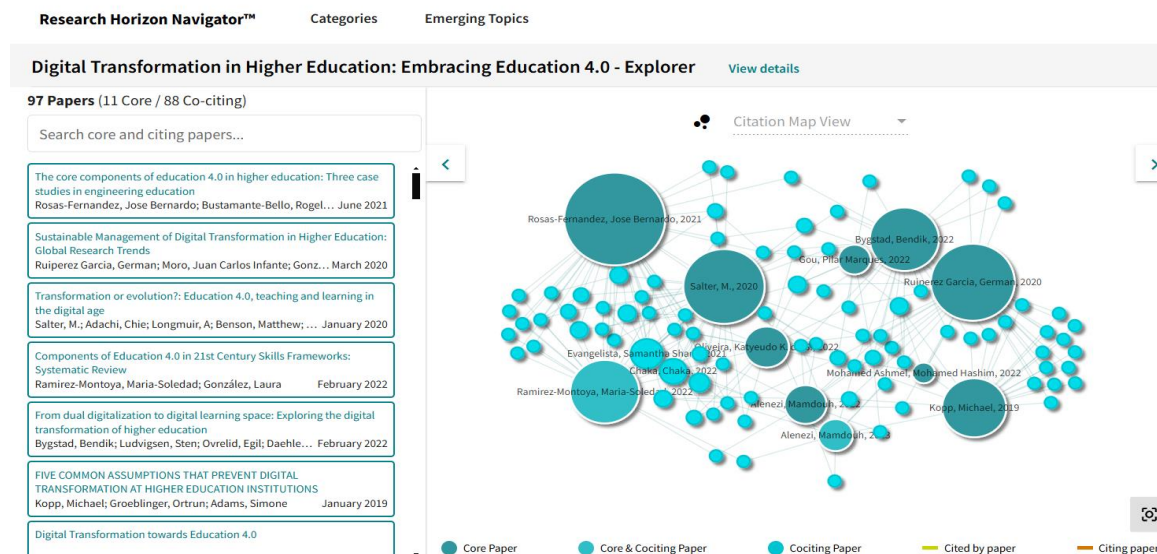


Figure 2. Co-authors grouped into multiple groups.

Source: Research Horizon Navigation''- Clarivate

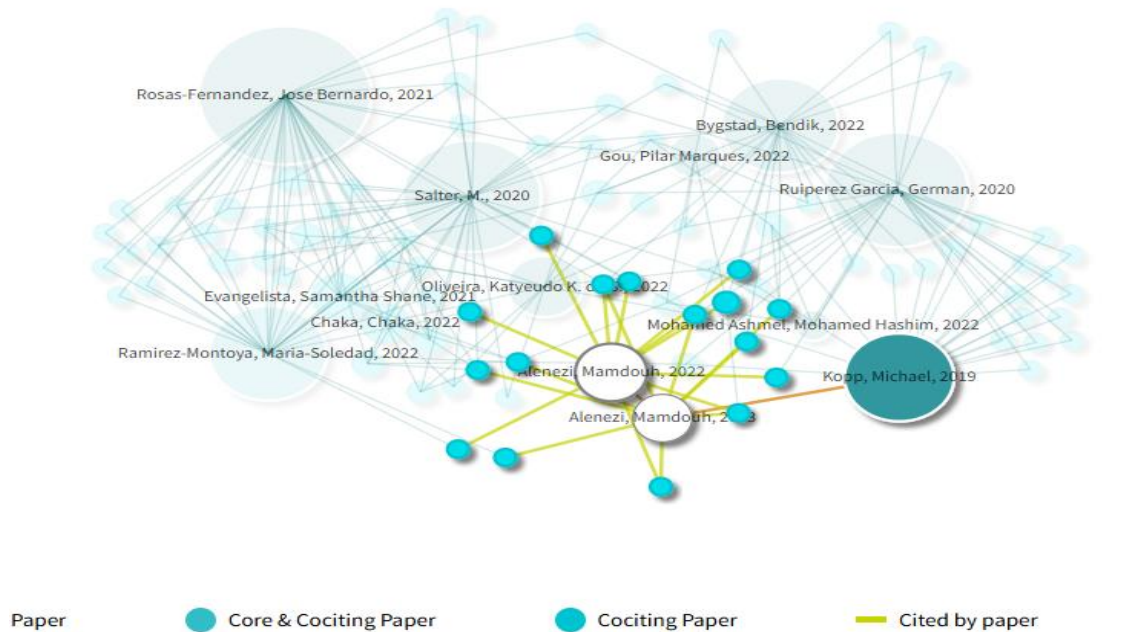
Authors such as Rosas-Fernandez, Jose Bernardo, Ruiperez Garcia, Salter or Ramirez-Montoya are the authors with the most articles published since 2019 and up to now, who have used as keywords: "sustainable development", "technology", "innovation", "environmental management" or "higher education". Following these published articles, global research followed an upward trend.

#### 3.2 Resource efficiency

The efficiency of resources is a very important thing in the context of the sustainability of universities, being essential for ensuring a positive impact on the three pillars, namely environmental, social and economic, implicitly reducing operational costs, but also promoting innovation. The adoption of measures such as the approach to efficient management of resources

or the creation of new alternatives regarding logistics through digital platforms, the creation of spaces for bicycles, electric scooters or public transport, Figure 3.

- ✓ *Efficient management of resources*: artificial intelligence supports universities in reducing energy consumption as well as in managing resources.
- ✓ *Logistics*: artificial intelligence helps to efficiently organize the timetable, allocate classrooms and manage the flow of students.



**Figure 3. Co-authors grouped and working in partnership**

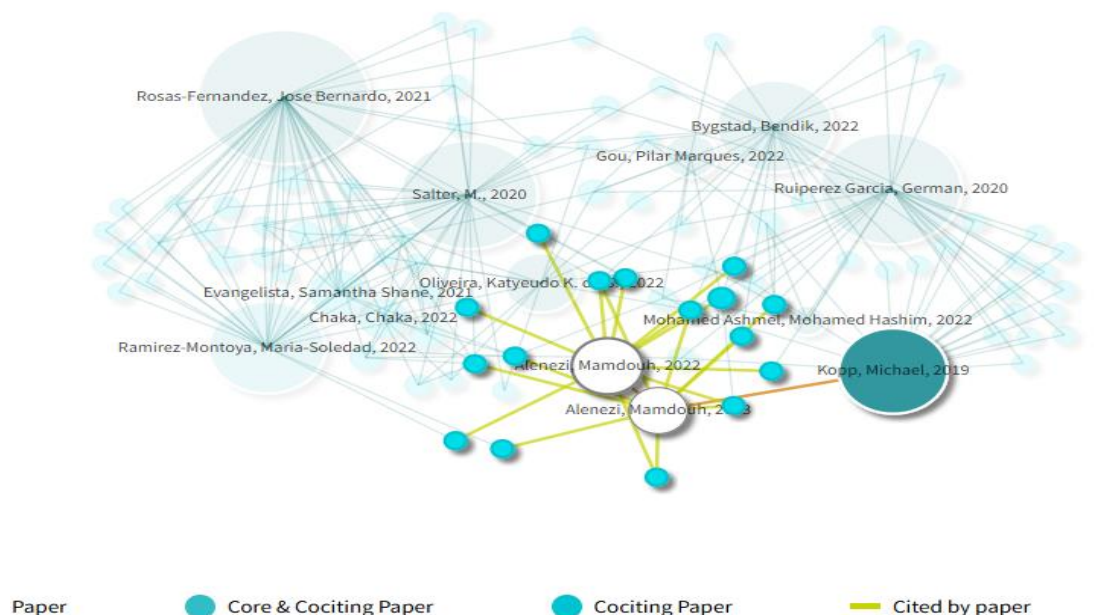
Source: Research Horizon Navigation™ - Clarivate

Partnerships within both national and international universities help accelerate the achievement of the 17 goals. In this figure, authors such as Kopp, Michael, Alenezi, Mamdouh, Saltern M., Rosas-Fernandez, Joes Bernardo, Ramirez-Mentoya or Maria-Soledad collaborated with common strategies regarding sustainable development. The collegial nature of higher education plays an essential role in educating global citizens by providing knowledge and innovation in society.

### 3.3 Education and research

More and more people in the field of education are concerned about the issue of digitization in higher education institutions. Therefore, one of the key factors of the universities was oriented towards the training of future managers in addressing the big problem of literacy and in search of new solutions, Figure 4. Research also plays an important role in higher education through the training of specialists capable of implementing sustainable solutions in various fields, but also by creating partnerships between universities and the private sector (Rampelt, 2019; Sarfraz, 2021).





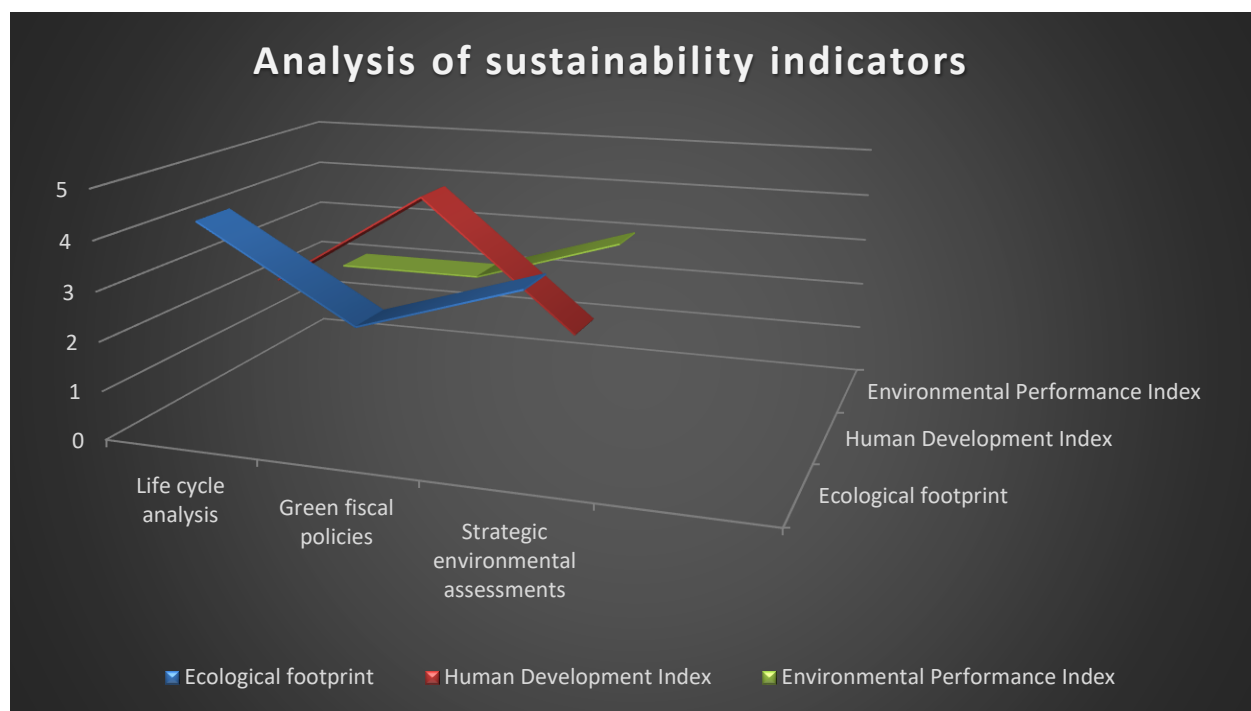
**Figure 4. Authors grouped in clusters regarding digital transformation**

Source: Research Horizon Navigation - Clarivate

The figure above shows the co-authors who have developed connections between them regarding digital transformation based on criteria such as common areas of research in digital development, previous collaborations, keywords, but also citation networks. All these connections allow the grouping of co-authors in the figure above.

#### 4. The theoretical framework regarding future sustainable development

Sustainable development is an important pawn in global policies and strategies aimed at balancing social, economic and environmental needs to ensure the well-being of current and future generations. The theoretical framework for future sustainable development is based on several fundamental principles and theories, which are integrated into international documents such as the United Nations 2030 Agenda and the Sustainable Development Goals (SDGs), Figure 5. In addition to the 17 goals and 169 targets that address global challenges such as eradicating poverty, protecting the environment and promoting peace, we can also recall the Paris Agreement of 2015, which represents the global commitment to limit global warming below 2° C from pre-industrial levels, with efforts to keep it at 1.5°C (Church, 1997; Global University Network for Innovation, 2019b; L. , & C. L. I. Ivascu, 2019).



**Figure 5. Analysis of sustainability indicators**

Sustainability indicators are tools used to evaluate and measure the performance and impact of an organization, community or nation from an economic, social and environmental point of view of sustainable development. Indicators help to monitor progress towards achieving sustainability goals, but also to make decisions. The main categories of sustainability indicators are environmental performance indicators, human development indicators and ecological footprint. In the figure above, based on these indicators, three tools such as: life cycle analysis, green fiscal policies and strategic environmental assessments were introduced, in order to compile an analysis based on them regarding sustainable development.

The 3 indicators were positioned on the vertical axis from 0 (low level) to 5 (increased level), where it can be seen that the environmental performance index has a slight stagnation, but then an increase can be seen regarding the assessment of the impact on the environment of a product, process or service. The 2nd indicator, namely the human development index, represents economic and fiscal measures aimed at encouraging ecological behaviors and reducing the unfavorable impact on the environment, and in the above figure a decrease can be observed. The 3rd indicator, the ecological footprint, can be seen in the whole process of integrating environmental considerations into strategic level plans, programs and policies, which are increasing. These three tools can contribute to more responsible management of resources and environmental protection, playing a key role in the transition to digital transformation.

## Conclusions

The artificial intelligence has an important impact on university sustainability, contributing to an accelerated transformation through administrative and operational optimization through the improvement of the learning process, consistent support in research as well as the involvement of the university community through collaboration platforms (Alina et al., 2021; Busu, 2021; Church, 1997; Marius et al., 2016)(Shahzad et al., 2024). Education for sustainable development is an

important concept as a response to contemporary global challenges such as climate change, depletion of natural resources and social inequality. This concept promotes an integrated approach to learning that supports the development of skills needed to build a more sustainable future. Through education for sustainable development, people can be equipped with the knowledge and skills to build a more resilient, just, and sustainable world. It will help shape capable, responsible citizens to make ethical decisions to support the well-being of future generations (L. Ivascu et al., 2021; Shahzad et al., 2024; Zhang et al., 2024).

The present work aims to answer the following questions:

1. Can technological change be resisted by traditionalist teachers or students?

Technological changes can be met with resistance from traditionalist teachers and students. This resistance can arise for the following reasons: lack of digital skills, perception of technology as a threat and reduction of direct interaction, preference for classic teaching methods considering them more effective, reluctance towards the effectiveness of new technological tools. A good measure in this case would be to adapt the educational process in such a way as to combine the two models, creating a hybrid approach, changes being inevitable in the future.

2. Can AI algorithms improve curriculum to individual student needs, helping academic performance and reducing dropout rates?

Artificial intelligence algorithms can be used to customize the curriculum according to the needs of students or teachers, helping to improve academic performance and reduce the dropout rate. AI can achieve this in several ways such as personalizing learning by adapting the pace of learning, identifying risks such as decreased student engagement, frequent absenteeism, and support from teachers by reducing educational barriers by providing good accessibility. Dropout reduction can be achieved through prompt interventions in the case of each student and helping him increase motivation.

In conclusion, universities that adopt artificial intelligence and sustainability can become leaders in education for a sustainable future, having a positive impact both in the university environment and on the community of which they are a part.

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