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ECONOMIC DECISION-MAKING BASED ON DATA STREAMS (BIG DATA) IN THE ADAPTIVE MANAGEMENT OF HIGHER EDUCATION

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Abstract

The paper examines how economic decisions can be made on the basis of large-scale data streams (Big Data) in the adaptive management of higher education institutions. The sharp rise in Uzbekistan's higher education enrolment rate in 2014–2024 is analysed as evidence of volatile demand, and students' digital activity is assessed as a new source of data. Data sources within a higher education institution and the economic decisions they support are systematised, and a six-stage adaptive management cycle is proposed.

Keywords: Big Data, adaptive management, higher education, economic decision, data stream, real-time analytics, feedback, higher education enrolment, digital footprint.

INTRODUCTION

The traditional management model assumes a stable external environment: a plan is drawn up for one year and evaluated at the end of that year. However, the pace of change in Uzbekistan's higher education system is making this approach ineffective. The higher education enrolment rate of the population aged 18–23



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rose from 6.8% in 2014 to 47.7% in 2024, an increase of 40.9 percentage points [1]. With the volume and structure of demand changing significantly every year, university leadership is forced to adjust decisions on admission quotas, tuition fees, staffing and teaching space quickly.

The form of management suited to these conditions is **adaptive management**, a system that continuously monitors changes in the external and internal environment and corrects decisions on the basis of feedback [5]. Its information base is a large, rapidly updated and heterogeneous data stream (Big Data). Students' digital activity is expanding this stream further: according to a survey of 3,839 students in 16 countries, 86% of students use AI tools in their studies, and 24% do so daily [2].

The aim of the study is to develop a mechanism for economic decision-making based on Big Data in the adaptive management of a higher education institution (HEI).

MAIN PART

Growth in the enrolment rate has been uneven (Figure 1): in 2014–2020 it rose by an average of about 2 percentage points per year, in 2020–2022 by almost 10 percentage points per year, and in 2022–2024 it slowed to 4–6 percentage points per year [1; 3]. Such uneven dynamics increase the errors of planning based on the previous year's figures: in periods of growth resources fall short, while in periods of slowdown surplus capacity appears.



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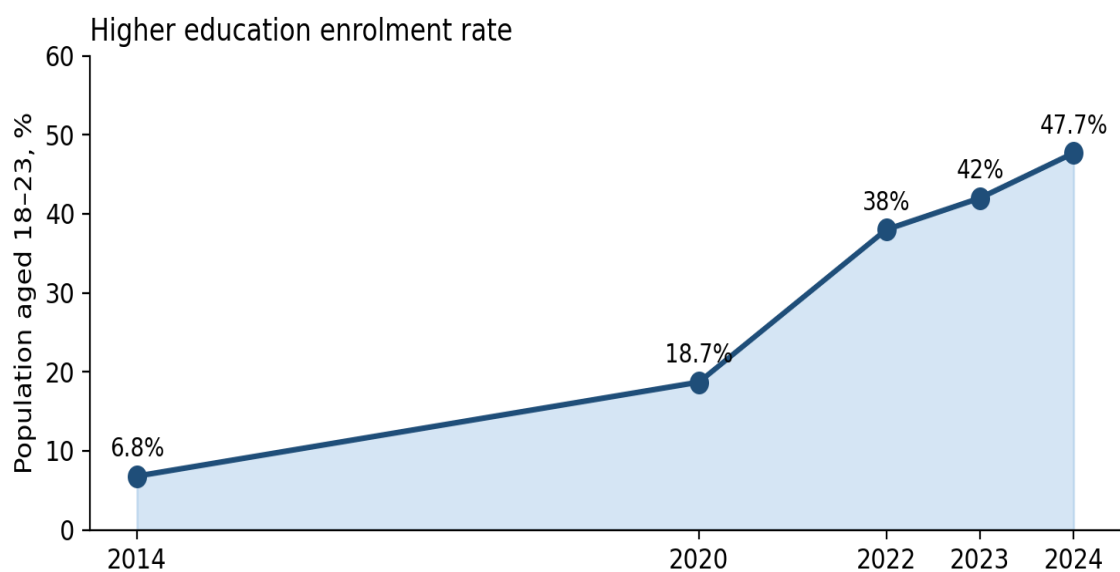


Figure 1. Higher education enrolment rate of the population aged 18–23 in Uzbekistan, %

Source: compiled by the author based on data from the National Statistics Committee of Uzbekistan [1] and Mentalaba.uz [3].

Data in an HEI are generated by several independent streams. From the perspective of the Big Data characteristics of volume, velocity, variety, veracity and value (5V) [4], each of them provides a basis for different economic decisions (Table 1).



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Table 1 HEI data streams and the economic decisions based on them

Data stream	Main characteristic (5V)	Update frequency	Economic decision
Admissions data	Volume, variety: applications, scores, programmes	Seasonal, real time	Setting admission quotas and tuition fees
Payment systems	Velocity: transaction flow	Daily	Cash-flow plan, discount and instalment policy
HEMIS (performance, attendance)	Volume, veracity	Weekly	Assessing dropout risk, preventing revenue loss
Digital learning platforms (LMS, AI tools)	Variety: text, log files	Continuous	Investment in digital resources and licences
Graduates and the labour market	Value: employment, wages	Annual / quarterly	Revising the programme portfolio
Financial and business accounting	Veracity: accounting records	Monthly	Cost optimisation, budget adjustment

Source: developed by the author.

Students' use of AI tools is also becoming a valuable source of data for HEIs (Figure 2). For example, 69% of students use AI to search for information, 42% to check grammar and 33% to summarise documents; 66% of respondents use ChatGPT, and each student uses an average of 2.1 AI tools [2]. These indicators allow an HEI to determine which digital services are economically worth licensing.



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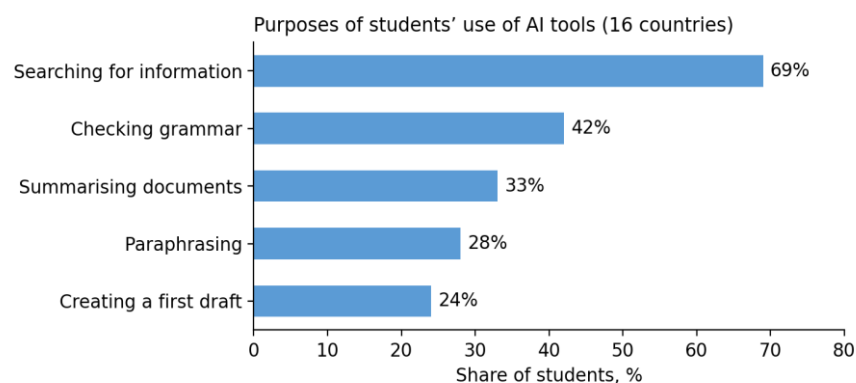


Figure 2. Purposes of students' use of AI tools, 2024

Source: compiled by the author based on the Digital Education Council Global AI Student Survey [2].

To turn the data stream into economic decisions, a six-stage adaptive management cycle is proposed (Figure 3). Its main difference from traditional annual planning is that the outcome of a decision is measured and returned as input to the next cycle, so decisions are corrected several times during the year.

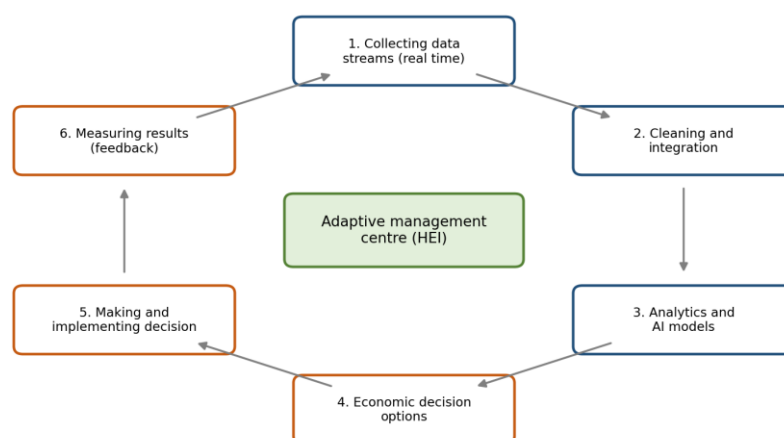


Figure 3. Big Data-based adaptive management cycle in an HEI

Source: developed by the author.



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Table 2 Comparison of traditional and adaptive management

Criterion	Traditional management	Big Data-based adaptive management
Planning period	Annual, fixed	Continuous, rolling plan
Information base	Statistical reports, previous year's data	Real-time data streams and forecasts
Speed of decision-making	Weeks and months	Hours and days
Error detection	At year end, through audit	Through early-warning signals
Resource allocation	Normative, equal distribution	Flexible, based on results and demand
Main risk	Delayed response to environmental change	Dependence on data quality and security

Source: developed by the author.

CONCLUSION AND RECOMMENDATIONS

The uneven and rapidly changing demand for higher education requires HEIs to move from static annual planning to adaptive management. Big Data is the information base for this transition, and its value lies not in the volume of data but in how quickly the data are turned into decisions. On this basis, the following recommendations are put forward:

1. Map data streams. Maintain a register in each HEI recording data sources, their owners, update frequency and quality indicators.
2. Move to a rolling budget. Introduce the practice of adjusting the HEI's income and expenditure estimate quarterly, based on real-time admissions and payment data.



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3. Early-warning system. Introduce a model that identifies a student's dropout risk from payment delays, attendance and performance data, thereby preventing loss of tuition revenue.
4. Data governance position. Establish a Chief Data Officer position in the HEI structure, responsible for data quality and security.
5. Ethical use of digital footprints. Set rules for using data on students' digital activity only in aggregated and anonymised form.

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