AI-ASSISTED DATA ANALYSIS: THE BALANCE BETWEEN AUTOMATION, ANALYTICAL CONTROL AND HUMAN DECISION IN THE EXCEL ECOSYSTEM

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MARIA MORARU
Academy of Economic Studies of Moldova
e-mail: morarumaria924@gmail.com
ORCID ID: 0009-0008-2499-8588

VARVARA TAPCOV
Academy of Economic Studies of Moldova
e-mail: varvara.tapcov@gmail.com
ORCID ID: 0009-0005-1775-3740

Abstract: Data analysis assisted by artificial intelligence has led to the expansion of the use of digital tools, positioning Microsoft Excel as a central element in modern ecosystems of information processing, analysis and visualization. In the context of accelerated digital transformation, organizations manage increasing volumes of data, and the need to automate analytical processes becomes essential for increasing operational efficiency and supporting the decision-making process. The paper examines the integration of artificial intelligence into the Excel ecosystem, with a focus on the interaction between automation, analytical control and human decision.

The research methodology includes a case study on data transformation in the sales field, using Power Query and the M language, assisted by AI tools and conversational models based on artificial intelligence. The study highlights how AI can automatically generate M-code for data transformation, reducing the technical complexity and time required to process information. At the same time, the limitations of automatically generated solutions are analyzed, especially in situations where the data structure evolves and requires further adaptations.

The results obtained highlight the reduction of processing time, the increase of analytical flexibility and the improvement of the process of creating dynamic reports. At the same time, the research confirms the need for validation and human intervention to ensure the scalability, robustness and correctness of analytical solutions.

The conclusions emphasize the importance of maintaining a balance between the efficiency of automation and analytical rigor in the context of business decisions. The paper proposes a practical model of human–AI collaboration in data transformation using Power Query and highlights the relevance of digital skills in modern data analysis processes.

Keywords: Artificial Intelligence; M code, Power Query, Copilot, Excel, human-AI collaboration.

JEL Classification: C88, M15, D83, O33.

INTRODUCTION

In today's economic environment, fast and well-founded decisions are essential for a company's success. Organizations collect huge amounts of data: sales, inventory, employee performance, reports downloaded from other systems or programs, financial data. Effective management and interpretation of this information can generate significant competitive advantages.

In the context of accelerated digital transformation, effective interpretation of information and data analysis is becoming an essential skill for professionals. Microsoft Excel, extended by Power

Query and Power BI, provides a robust ecosystem for data manipulation and visualization. The emergence of artificial intelligence tools (such as Copilot or conversational models) introduces a new level of automation, reducing technical barriers and increasing productivity. This automation raises important questions regarding the control over the analytical process and the validity of the results. Thus, a balanced approach between the use of AI and human expertise is needed, because business context, nuance interpretation, and risk taking cannot be completely outsourced to machines (figure 1).

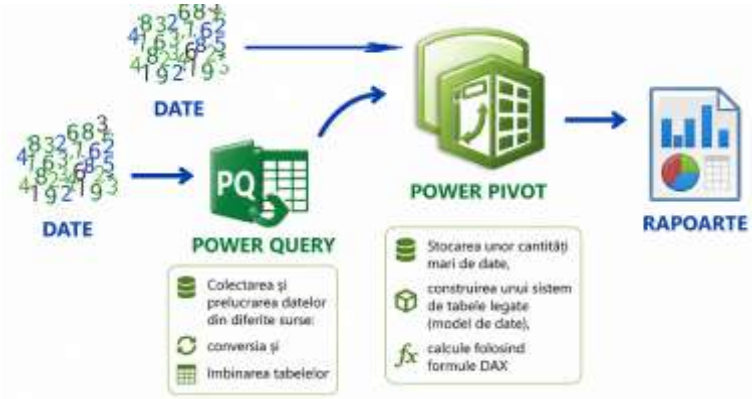


Figure 1. AI process flow in data analysis.
Source: *Authors' view.*

Excel, integrated with Power Query, Power Pivot, and Copilot, is a powerful ecosystem for AI-powered data analysis. With these tools, business professionals can:

- Import and consolidate data from multiple sources (Excel files, databases, cloud, OneDrive/SharePoint).
- Automate data transformation (standardization, elimination of duplicates, automatic calculation of KPI indicators).
- Generate dynamic reports that make it easy to monitor business performance.
- Get analysis and formula suggestions through Copilot, saving time and reducing manual errors.

MAIN CONTENT

The purpose of this article is to present the balance between automation, analytical control, and human decision-making, in the business context, highlighting both theoretical concepts and practical examples, with a focus on data security and integrity in the Excel ecosystem.

1. The role of artificial intelligence in data analysis in Excel

Artificial intelligence contributes significantly to:

- automatic generation of formulas and codes (including M-code for Power Query);
- identifying patterns and anomalies in data sets;
- automation of repetitive processes, report creation and decision making;
- assisting the user in building analytical models.

A major advantage is AI's ability to translate requirements formulated in natural language into concrete technical steps.

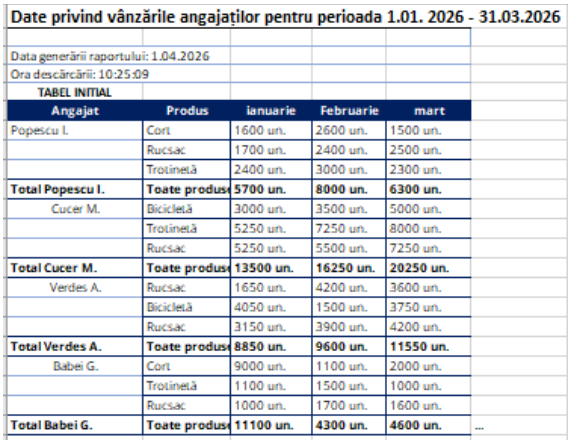
2. Power Query and M language – AI-assisted automation

Power Query is an essential tool for data processing in Excel. The M language allows you to define transformations in a declarative way.

By using AI, the process of writing M-code becomes much more accessible. Instead of manually constructing each step, the user can describe the desired result and the AI generates the script.

3. Automate repetitive processes, create reports and make decisions

The paper proposes a practical model of **human–AI collaboration** in data transformation using Power Query. The analyzed dataset, figure 2, is extracted from an Excel file from an external source and contains information about the sales made by employees of a company for a period of time. The data is presented in a hierarchical structure and has an unsuitable format (wide format) for analysis and reporting.



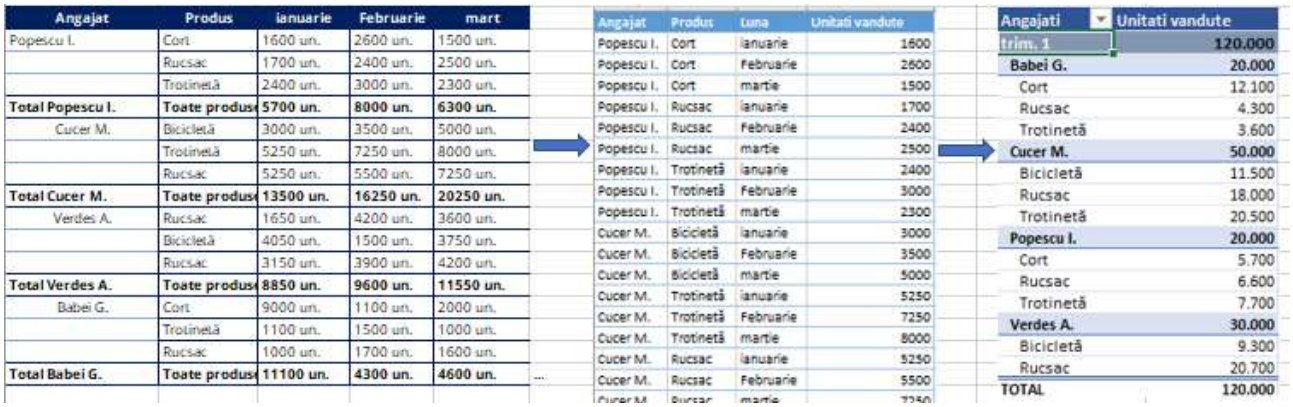
Date privind vânzările angajaților pentru perioada 1.01. 2026 - 31.03.2026

Data generării raportului: 1.04.2026
Ora descărcării: 10:25:09
TABEL INITIAL

Angajat	Produs	ianuarie	Februarie	mart
Popescu I.	Cort	1600 un.	2600 un.	1500 un.
	Rucsac	1700 un.	2400 un.	2500 un.
	Trotinetă	2400 un.	3000 un.	2300 un.
Total Popescu I.	**Toate produs**	**5700 un.**	**8000 un.**	**6300 un.**
Cucer M.	Bicicletă	3000 un.	3500 un.	5000 un.
	Trotinetă	5250 un.	7250 un.	8000 un.
	Rucsac	5250 un.	5500 un.	7250 un.
Total Cucer M.	**Toate produs**	**13500 un.**	**16250 un.**	**20250 un.**
Verdes A.	Rucsac	1650 un.	4200 un.	3600 un.
	Bicicletă	4050 un.	1500 un.	3750 un.
	Rucsac	3150 un.	3900 un.	4200 un.
Total Verdes A.	**Toate produs**	**8850 un.**	**9600 un.**	**11550 un.**
Babei G.	Cort	9000 un.	1100 un.	2000 un.
	Trotinetă	1100 un.	1500 un.	1000 un.
	Rucsac	1000 un.	1700 un.	1600 un.
Total Babei G.	**Toate produs**	**11100 un.**	**4300 un.**	**4600 un.**

Figure 2. Source table exported from the external system.
Source: *Data processed by the authors.*

Based on this table, it is necessary to answer the question: " *What total quantity of goods were sold in the first quarter and what are the sales indicators for the following periods of time (months, quarters, years)? The answer should be reported as in the image, figure 3"*



Angajat	Produs	ianuarie	Februarie	mart
Popescu I.	Cort	1600 un.	2600 un.	1500 un.
	Rucsac	1700 un.	2400 un.	2500 un.
	Trotinetă	2400 un.	3000 un.	2300 un.
Total Popescu I.	**Toate produs**	**5700 un.**	**8000 un.**	**6300 un.**
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	Trotinetă	1100 un.	1500 un.	1000 un.
	Rucsac	1000 un.	1700 un.	1600 un.
Total Babei G.	**Toate produs**	**11100 un.**	**4300 un.**	**4600 un.**

Angajat	Produs	Luna	Unitati vandute
Popescu I.	Cort	ianuarie	1600
Popescu I.	Cort	Februarie	2600
Popescu I.	Cort	martie	1500
Popescu I.	Rucsac	ianuarie	1700
Popescu I.	Rucsac	Februarie	2400
Popescu I.	Rucsac	martie	2500
Popescu I.	Trotinetă	ianuarie	2400
Popescu I.	Trotinetă	Februarie	3000
Popescu I.	Trotinetă	martie	2300
Cucer M.	Bicicletă	ianuarie	3000
Cucer M.	Bicicletă	Februarie	3500
Cucer M.	Bicicletă	martie	5000
Cucer M.	Trotinetă	ianuarie	5250
Cucer M.	Trotinetă	Februarie	7250
Cucer M.	Trotinetă	martie	8000
Cucer M.	Rucsac	ianuarie	5250
Cucer M.	Rucsac	Februarie	5500

Angajati	Unitati vandute
trim. 1	120.000
Babei G.	**20.000**
Cort	12.100
Rucsac	4.300
Trotinetă	3.600
Cucer M.	**50.000**
Bicicletă	11.500
Rucsac	18.000
Trotinetă	20.500
Popescu I.	**20.000**
Cort	5.700
Rucsac	6.600
Trotinetă	7.700
Verdes A.	**30.000**
Bicicletă	9.300
Rucsac	20.700
TOTAL	120.000

Figure 3. Table transformation.
Source: *Data processed by the authors.*

There are several methodological approaches, which require a knowledge base regarding the method that will be used to transform the hierarchical table:

- Power Query interface, which requires advanced knowledge of this tool
- Writing M code, which requires knowledge of the respective language with all the rules for writing functions distributed across objects
- Creating macros, which requires knowledge of the VBA language

- Using Artificial Intelligence to write M-code, which requires correct prompt writing

4. Using Artificial Intelligence to write M-code

The AI process flow in data analysis boils down to the algorithm: Prompt → AI → M-Code → Result → Human Validation

The text of the request (Prompt) for solving the problem in the case study is:

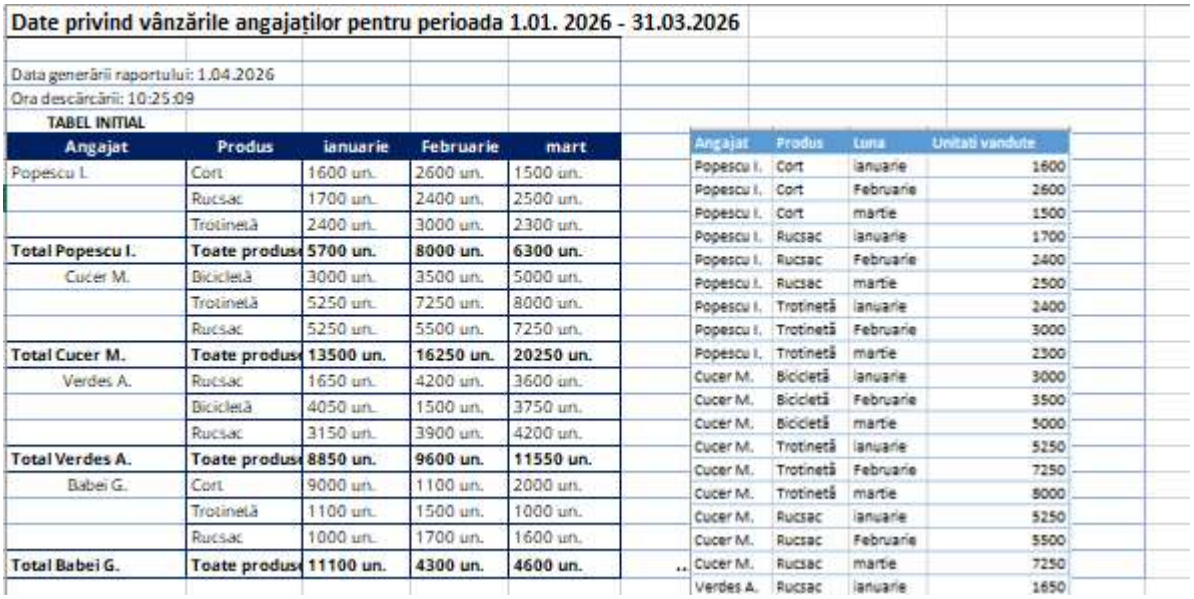
"Write an M code that imports and transforms a table from a hierarchical form to an analytical structure. My file is here: C:\Users\User\file_name.xlsx
Retrieve data from the sheet: [Sheet name: "Sales"].
I want to receive the table with the following structure: Employee, Product, Month, Period, Units sold, and the first row to contain, for example, the values: Popescu I, Cort, January, 01.01.2026, quarter 1, 1600
Code requirements:
Start the query by loading the file and sheet specified above.
It only uses standard functions, even those compatible with Excel 2016.
Avoid new, experimental, or rare functions (e.g. Expression.Evaluate).
Use actions that can be reproduced through the editor interface ("Fill → Down, "Replace, Transform, etc.).
If the logic is short and uses standard functions, embed it directly into the main query.
If the logic is complex, multi-step, or potentially reusable, extract it into a separate query function with a clear name (for example: fnFillDownGroups ".

The resulting AI-generated M-code, figure 4, transforms the case study table into an easy-to-analyze, "flat" format:

```
let
Source = Excel.CurrentWorkbook(){[Name="TabelSursa"]}[Content],
#"Removed Top Rows" = Table.Skip(Source, 4),
#"Promoted Headers" = Table.PromoteHeaders(#"Removed Top Rows", [PromoteAllScalars=true]),
#"Renamed Columns" = Table.RenameColumns(#"Promoted Headers",{
{"ianuarie", "Ianuarie"},
{"Februarie", "Februarie"},
{"mart", "Mart"}}),
#"Filtered Rows" = Table.SelectRows(#"Renamed Columns",
each not Text.StartsWith(Text.From([Angajat]), "Total")),
#"Filled Down" = Table.FillDown(#"Filtered Rows",{"Angajat"}),
#"Filtered Null Products" = Table.SelectRows(#"Filled Down",
each [Produs] <> null and [Produs] <> ""),
#"Unpivoted Columns" = Table.UnpivotOtherColumns(
#"Filtered Null Products",
{"Angajat", "Produs"},"Luna","Unitati_vandute"),
#"Removed Text" = Table.TransformColumns(
#"Unpivoted Columns",
{{"Unitati_vandute",
each Text.Replace(Text.From(_), "un.", ""), type text}}),
#"Trimmed Text" = Table.TransformColumns(#"Removed Text",
{{"Unitati_vandute", Text.Trim, type text}}),
#"Changed Type" = Table.TransformColumnTypes(
#"Trimmed Text",{{"Unitati_vandute", Int64.Type}})
in
#"Changed Type"
```

Figure 4. M-code for transforming the table structure.
Source: *Developed by the authors with AI support.*

This code demonstrates how AI can speed up the technical process, reducing complexity for the user. After implementing the code in the Power Query Editor, the result seems to be obtained, figure 5, but when adding new information, the results become inconsistent in certain scenarios.



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Data generării raportului: 1.04.2026
Ora descărcării: 10:25:09

TABEL INITIAL

Angajat	Produs	ianuarie	Februarie	mart
Popescu I.	Cort	1600 un.	2600 un.	1500 un.
	Rucsac	1700 un.	2400 un.	2500 un.
	Trotinetă	2400 un.	3000 un.	2300 un.
Total Popescu I.	**Toate produs**	**5700 un.**	**8000 un.**	**6300 un.**
Cucer M.	Bicicletă	3000 un.	3500 un.	5000 un.
	Trotinetă	5250 un.	7250 un.	8000 un.
	Rucsac	5250 un.	5500 un.	7250 un.
Total Cucer M.	**Toate produs**	**13500 un.**	**16250 un.**	**20250 un.**
Verdes A.	Rucsac	1650 un.	4200 un.	3600 un.
	Bicicletă	4050 un.	1500 un.	3750 un.
	Rucsac	3150 un.	3900 un.	4200 un.
Total Verdes A.	**Toate produs**	**8850 un.**	**9600 un.**	**11550 un.**
Babei G.	Cort	9000 un.	1100 un.	2000 un.
	Trotinetă	1100 un.	1500 un.	1000 un.
	Rucsac	1000 un.	1700 un.	1600 un.
Total Babei G.	**Toate produs**	**11100 un.**	**4300 un.**	**4600 un.**

Angajat	Produs	Luna	Unitati vandute
Popescu I.	Cort	ianuarie	1600
Popescu I.	Cort	Februarie	2600
Popescu I.	Cort	martie	1500
Popescu I.	Rucsac	ianuarie	1700
Popescu I.	Rucsac	Februarie	2400
Popescu I.	Rucsac	martie	2500
Popescu I.	Trotinetă	ianuarie	2400
Popescu I.	Trotinetă	Februarie	3000
Popescu I.	Trotinetă	martie	2300
Cucer M.	Bicicletă	ianuarie	3000
Cucer M.	Bicicletă	Februarie	3500
Cucer M.	Bicicletă	martie	5000
Cucer M.	Trotinetă	ianuarie	5250
Cucer M.	Trotinetă	Februarie	7250
Cucer M.	Trotinetă	martie	8000
Cucer M.	Rucsac	ianuarie	5250
Cucer M.	Rucsac	Februarie	5500
Cucer M.	Rucsac	martie	7250
Verdes A.	Rucsac	ianuarie	1650

Figure 5. The result obtained after installing the code.

Source: *Data processed by the authors.*

Human intervention is necessary here to permanently resolve the problem.

5. Limitations of AI and the need for human intervention

AI-generated solutions may depend on the structure of the data, may require human adjustments and validation, and are not always generalizable.

A key issue observed in practice arises when the data structure evolves. For example, if a new column for the month "April" is added to the original table, the code initially generated by the AI may no longer work as expected and may require adjustments, figure 6.



Date privind vânzările angajaților pentru perioada 01.012026 - 30.04.2026

Data generării raportului: 1.05.2026
Ora descărcării: 10:25:09

TABEL INITIAL

Angajat	Produs	ianuarie	Februar	mart	Aprilie
Popescu I.	Cort	1600 un.	2600 un.	1500 un.	150000 un.
	Rucsac	1700 un.	2400 un.	2500 un.	250000 un.
	Trotinetă	2400 un.	3000 un.	2300 un.	2300 un.
Total Popescu I.	**Toate produs**	**5700 un.**	**8000 un.**	**6300 un.**	**6300 un.**
Cucer M.	Bicicletă	3000 un.	3500 un.	5000 un.	5000 un.
	Trotinetă	5250 un.	7250 un.	8000 un.	8000 un.
	Rucsac	5250 un.	5500 un.	7250 un.	7250 un.
Total Cucer M.	**Toate produs**	**13500 un.**	**16250 un.**	**20250 un.**	**20250 un.**

Angajat	Produs	Luna	Unitati vandute
Popescu I.	Cort	ianuarie	1600
Popescu I.	Cort	Februarie	2600
Popescu I.	Cort	martie	1500
Popescu I.	Rucsac	ianuarie	1700
Popescu I.	Rucsac	Februarie	2400
Popescu I.	Rucsac	martie	2500
Popescu I.	Trotinetă	ianuarie	2400
Popescu I.	Trotinetă	Februarie	3000

Figure 6. The result obtained after adding information.

Source: *Data processed by the authors.*

This highlights an important limitation: AI generates correct solutions for the current context, but not always generalized to future scenarios.

In this case, human expertise comes in, which must adapt the code to become flexible and reusable.

Improved M-code (dynamic and scalable)

To make the solution robust to adding new information (e.g. April, May, ... etc.) or even different years, the code must be adjusted to dynamically identify month columns. The human intervention consists of continuing the dialogue with the AI after detecting that when adding the month " April", the result does not adjust.

The next request to the AI is: *"Rewrite the code so that when adding new periods we automatically obtain the adjusted result for those periods."*

As a result of implementing the new AI-generated code, figure 7, the problem will be solved.

```
let
    Source = Excel.CurrentWorkbook(){[Name="Table1"]}[Content],
    #"Changed Type" = Table.TransformColumnTypes(Source,{{"Angajat", type text}, {
    #"Filtered Rows" = Table.SelectRows(#"Changed Type", each ([Angajat] <> "Total
    #"Filled Down" = Table.FillDown(#"Filtered Rows",{"Angajat"}),
    #"Unpivoted Other Columns" = Table.UnpivotOtherColumns(#"Filled Down", {"Angaj
    #"Replaced Value" = Table.ReplaceValue(#"Unpivoted Other Columns","mart","Mart
    #"Added Prefix" = Table.TransformColumns(#"Replaced Value", {{"Attribute", eac
    #"Added Suffix" = Table.TransformColumns(#"Added Prefix", {{"Attribute", each
    #"Changed Type1" = Table.TransformColumnTypes(#"Added Suffix",{{"Attribute", t
    #"Replaced Value1" = Table.ReplaceValue(#"Changed Type1","un.","",Replacer.Rep
    #"Changed Type2" = Table.TransformColumnTypes(#"Replaced Value1",{{"Value", In
    #"Renamed Columns" = Table.RenameColumns(#"Changed Type2",{{"Attribute", "Data
    #"Inserted Month Name" = Table.AddColumn(#"Renamed Columns", "Month Name", eac
    #"Reordered Columns" = Table.ReorderColumns(#"Inserted Month Name",{"Angajat",
    #"Inserted Quarter" = Table.AddColumn(#"Reordered Columns", "Quarter", each Da
    #"Reordered Columns1" = Table.ReorderColumns(#"Inserted Quarter",{"Angajat", "
    #"Added Custom" = Table.AddColumn(#"Reordered Columns1", "Tip Perioada", each
    #"Merged Columns" = Table.CombineColumns(Table.TransformColumnTypes(#"Added Cu
    #"Reordered Columns2" = Table.ReorderColumns(#"Merged Columns",{"Angajat", "Pr
    #"Renamed Columns1" = Table.RenameColumns(#"Reordered Columns2",{{"Month Name"
in
    #"Renamed Columns1"
```

Figure 7. New M-code for data transformation.
Source: *Developed by the authors with AI support.*

This version no longer depends on a fixed number of months and will work correctly even if new information with months, years, etc. is added, figure 8.

Angajat	Produs	Data	Luna	Perioada	Unitati vandute
Popescu I.	Cort	01.01.2026	ianuarie	trim 1	1600
Popescu I.	Cort	01.02.2026	februarie	trim 1	2600
Popescu I.	Cort	01.03.2026	martie	trim 1	1500
Popescu I.	Cort	01.04.2026	aprilie	trim 2	150000
Popescu I.	Rucsac	01.01.2026	ianuarie	trim 1	1700
Popescu I.	Rucsac	01.02.2026	februarie	trim 1	2400
Popescu I.	Rucsac	01.03.2026	martie	trim 1	2500
Popescu I.	Rucsac	01.04.2026	aprilie	trim 2	250000

Luni	Unitati vandute
ianuarie	39.150
februarie	38.150
martie	42.700
aprilie	438.700
TOTAL	558.700

Figure 8. Result obtained after modifying the M code.
Source: *Data processed by the authors.*

The difference between the two code variants clearly highlights the relationship between AI and user:

- AI offers a quick and functional solution **initially**;
- the user ensures generalization and robustness;
- the collaboration between the two leads to scalable solutions.

This example represents a concrete demonstration of the central idea addressed: the balance between automation (AI) and analytical control (OM), with the following benefits:

- reducing processing time;
- elimination of manual errors;
- scalability;
- easy integration into Power BI.

Although AI simplifies the technical process, analytical control remains essential. The final decision belongs to the user, who must validate the correctness of the transformations, the relevance

of the indicators and the coherence of the obtained results. Tools based on artificial intelligence can quickly generate formulas, M-code or analysis suggestions, but they do not automatically guarantee the contextual accuracy of the processed data.

In practice, the user becomes not only a consumer of the results generated by AI, but also a critical evaluator of them. Thus, analytical skills, professional experience and the ability to interpret information remain determining factors in the decision-making process. AI should be seen as a support mechanism for increasing productivity and automating repetitive operations, not as a complete substitute for human expertise.

In the context of the Microsoft Excel and Power Query ecosystem, AI and user collaboration contribute to the development of a modern data analysis model characterized by flexibility, speed and operational efficiency. At the same time, human validation reduces the risk of transformation errors, incorrect interpretations and erroneous analytical conclusions.

Integrating AI into Excel and Power Query is an important step in democratizing data analysis. The case study demonstrates the effectiveness of using AI to generate M-code and transform data into an analyzable format.

An additional relevant element is the ability to quickly build reports. For example, after transforming the data, an interactive report can be generated that shows the evolution of sales by months, years and products, facilitating the identification of trends, figure 9.

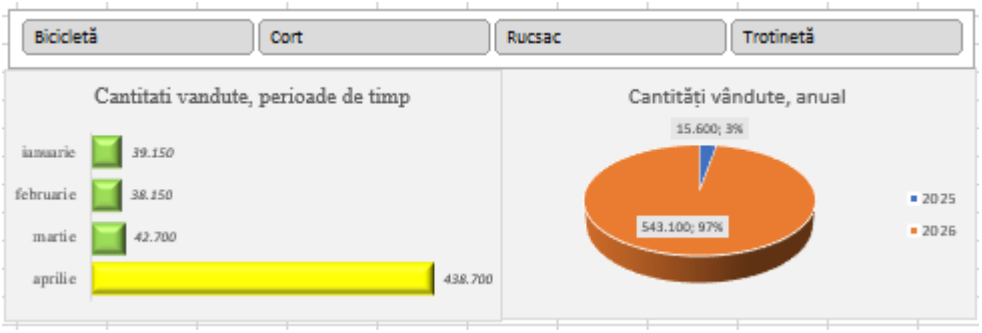


Figure 9. Adjustable ratio.
Source: *Data processed by the authors.*

The future belongs to human-AI collaboration, where automation accelerates processes and human expertise ensures the validity and relevance of decisions.

The main contribution of the paper consists in the practical demonstration of the limits of artificial intelligence-based automation in the data transformation process, as well as in highlighting the critical role of human intervention for the development of scalable, robust and adaptable analytical solutions to structural changes in data.

CONCLUSIONS

The research results demonstrate that integrating Artificial Intelligence tools into the Microsoft Excel and Power Query ecosystem significantly contributes to optimizing the transformation and analysis processes of commercial data. The case study conducted on a report exported from an external source highlighted that the use of AI-assisted generated M-code allows the automation of repetitive data processing steps, reducing the time required to transform the tabular structure and diminishing the risk of operational errors.

A relevant result of the research is the demonstration that AI models can accelerate the development process of ETL (Extract–Transform–Load) solutions, even in the case of unstructured

or partially standardized reports. The originality of the study derives from the combination of AI components with Power Query mechanisms to obtain a reusable and updatable analytical flow through Refresh operations. Thus, the research proposes a practical model of collaboration between the user and AI in the data analysis process, contributing to the development of the concept of augmented *analytics*.

The results confirm the conclusions of recent research on the role of AI in automating analytical processes and increasing business user productivity. However, the study also highlights an important conclusion that partially contrasts with some optimistic approaches in the specialized literature: AI does not eliminate the need for human validation. In the experiment conducted, some automatically generated transformations required manual adjustments to ensure semantic coherence and accuracy of the final results. This observation supports the idea that analytical expertise remains essential in the interpretation and validation of automatically processed data.

Another important result is highlighting the flexibility of Power Query in integrating data streams from heterogeneous external sources. The automatic transformation of a non-uniform report into a normalized tabular structure demonstrated the high potential of Microsoft tools for quickly building analytical models usable in Excel and Power BI.

However, the research has some limitations. The study was conducted on a small set of commercial data and a single tabular transformation scenario, without the integration of Big Data sources or advanced predictive AI models. Also, the performance of the solution may vary depending on the quality of the source data and the complexity of the imported structures.

Future research directions may include extending the proposed model by integrating Microsoft Copilot, Power Automate, and cloud services from the Microsoft 365 ecosystem. The possibilities of using AI for automatic anomaly detection, predictive generation of performance indicators, and development of intelligent reports in Power BI can also be analyzed. Another relevant direction is the assessment of the impact of AI on the digital skills of financial analysts and on the organizational decision-making process.

In conclusion, the research confirms that the combined use of AI, Excel and Power Query is an effective solution for the digital transformation of analytical processes. The benefits obtained are reflected in the increase in processing speed, the flexibility of data updates and the efficiency of reporting activities, but the success of the implementation still depends on the user's ability to critically validate and interpret the automatically generated results.

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