

Designing Productivity Outcomes of Fixed Asset Revaluation Based on Matrix Processes

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ABSTRACT

The objective of this study is to design the productivity outcomes of fixed asset revaluation based on matrix processes. In terms of methodology, the study is exploratory and, through two qualitative and quantitative phases, seeks to achieve its analytical objectives by identifying emerging dimensions of the focal phenomenon and ranking the identified core dimensions within the context of petrochemical companies. In the qualitative phase, grounded theory analysis and interviews were employed, and through three stages of coding, a polygonal theoretical framework was developed. In the quantitative phase, based on a pairwise comparison matrix, the core components of the theoretical framework were examined in row "i" and column "j" to ultimately prioritize the core dimensions using matrix scoring percentages. The results obtained in the qualitative phase indicated that, based on conducting 14 interviews with qualified experts, a total of 208 open codes, 30 conceptual themes, 6 core components, and 3 structural categories were identified and presented within a polygonal framework. Furthermore, in the quantitative phase, the results indicated that the component of asset operational capacity is the most central productivity outcome resulting from the revaluation of fixed assets in petrochemical companies. This finding suggests that when asset values are revised based on real market conditions and current economic value, more accurate and realistic information becomes available to managers regarding production capacity, operational line capabilities, equipment depreciation, and cash flow generation power. Such information directly influences operational decision-making and enables more precise planning for maintenance, repair, and asset replacement.

Keywords: Fixed asset revaluation, productivity outcomes, matrix processes

Introduction

The increasing complexity of contemporary financial systems and the growing reliance on asset-based valuation mechanisms have significantly transformed the role of fixed assets in corporate decision-making and performance evaluation. In modern financialized economies, assets are no longer viewed merely as static resources but as dynamic instruments of value creation, risk management, and strategic positioning. This transformation, often conceptualized within the broader framework of assetization, underscores the importance of accurately measuring and managing assets to enhance firm-level productivity and competitiveness (1). In this context, the revaluation of fixed assets has emerged as a critical accounting practice that aligns book values with market realities, thereby improving the informational content of financial statements and enabling more informed managerial decisions. The



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adoption of fair value accounting standards, particularly under IFRS, has further institutionalized this practice and contributed to the convergence of global accounting systems, reinforcing the relevance of asset revaluation in both developed and emerging markets (2, 3).

The theoretical and empirical literature suggests that fixed asset revaluation plays a pivotal role in enhancing the transparency and comparability of financial reporting. By updating asset values to reflect current market conditions, firms can provide more relevant information to investors, creditors, and other stakeholders, thereby reducing information asymmetry and improving capital allocation efficiency. Empirical studies have demonstrated that the application of fair value accounting improves the value relevance of financial information, particularly when supported by robust institutional frameworks and regulatory oversight (4, 5). Furthermore, the measurement of fixed assets under IFRS has been shown to be influenced by firm-specific characteristics, institutional environments, and managerial incentives, highlighting the multifaceted nature of asset revaluation practices (6). These findings underscore the need for a comprehensive analytical framework that captures the diverse productivity outcomes associated with asset revaluation processes.

From a financial performance perspective, asset revaluation has significant implications for firms' capital structure, liquidity, and risk profile. By increasing the book value of assets, revaluation can enhance a firm's borrowing capacity, improve leverage ratios, and facilitate access to external financing. This is particularly important in environments characterized by financial constraints or economic sanctions, where internal reserves and asset-based collateral play a crucial role in sustaining growth and stability (7). Additionally, the revaluation of assets has been linked to improvements in financial stability and resilience, as it enables firms to better absorb shocks and manage uncertainties in volatile markets. The relationship between asset structure and financial performance stability further highlights the strategic importance of asset revaluation in maintaining long-term organizational sustainability (8).

The productivity implications of asset revaluation extend beyond financial metrics to encompass operational efficiency and resource utilization. By providing a more accurate representation of asset values, revaluation enables firms to optimize the allocation of resources, identify underutilized assets, and improve the efficiency of production processes. This aligns with broader productivity measurement frameworks, such as the Malmquist index, which emphasize the role of technological change and efficiency improvements in driving organizational performance (9, 10). Studies in the banking and financial sectors have also demonstrated that productivity gains are closely linked to the effective management of assets and the adoption of advanced analytical tools for performance evaluation (11, 12). These insights suggest that asset revaluation can serve as a catalyst for enhancing operational productivity by enabling more informed and data-driven decision-making.

In addition to operational and financial dimensions, asset revaluation also influences strategic decision-making processes within organizations. By providing updated and reliable information on asset values, revaluation supports the formulation of long-term investment strategies, capital budgeting decisions, and risk management policies. The integration of asset-based information into strategic planning frameworks enhances firms' ability to respond to changing market conditions and exploit emerging opportunities. This is consistent with research on the causal relationships among factors influencing competitive advantage, which highlights the importance of structured decision-making models in improving organizational outcomes (13, 14). Moreover, the role of financial literacy and managerial competence in interpreting asset-related information further emphasizes the need for robust analytical frameworks that facilitate the effective use of revaluation data in strategic contexts (15).

The institutional environment in which firms operate also plays a critical role in shaping the outcomes of asset revaluation practices. Institutional quality, regulatory compliance, and governance mechanisms influence the extent to which revaluation contributes to efficiency and performance improvements. Empirical evidence suggests that strong institutional frameworks enhance technical efficiency and support the effective implementation of accounting standards, thereby amplifying the benefits of asset revaluation (16). Additionally, the alignment of financial reporting practices with international standards not only improves transparency but also enhances firms' credibility in global capital markets. This is particularly relevant in the context of emerging economies, where institutional reforms and regulatory convergence are key drivers of economic development (17).

Despite the growing body of literature on asset revaluation, several gaps remain in understanding its productivity outcomes and the underlying mechanisms through which these outcomes are realized. While prior studies have examined the impact of revaluation on financial performance, market valuation, and risk, relatively limited attention has been paid to the multidimensional nature of productivity outcomes and their interrelationships. For instance, the effect of revaluation on stock price crash risk highlights the complex interplay between financial reporting practices and market dynamics, suggesting that the benefits of revaluation may be contingent on firm-specific and contextual factors (18). Similarly, research on fair value accounting and conditional conservatism indicates that the adoption of revaluation practices may have nuanced effects on accounting quality and earnings management (19). These findings underscore the need for a more integrated analytical approach that captures the diverse and interrelated dimensions of productivity outcomes associated with asset revaluation.

Furthermore, the concept of asset revaluation must be understood within the broader context of organizational transformation and structural change. The modification of asset structures, as part of regional and industrial restructuring processes, reflects the dynamic nature of economic systems and the need for continuous adaptation to evolving market conditions (20). In this regard, asset revaluation can be viewed as a strategic tool for facilitating organizational change and enhancing competitiveness. The integration of asset efficiency, financial performance, and governance mechanisms into a unified framework further highlights the interconnectedness of these factors in driving sustainable growth (21).

In light of these considerations, there is a clear need for a comprehensive and systematic framework that captures the productivity outcomes of fixed asset revaluation and provides a basis for their analysis and prioritization. Such a framework should account for the multidimensional nature of productivity, including operational, financial, informational, and institutional aspects, and should incorporate both qualitative and quantitative methodologies to ensure robustness and validity. Previous research has emphasized the importance of grounded theory and structural modeling approaches in developing such frameworks, particularly in contexts characterized by complexity and uncertainty (22, 23). Moreover, the use of advanced analytical techniques, such as fuzzy interpretive structural modeling, can enhance the understanding of interrelationships among components and support the identification of key drivers of productivity outcomes.

Accordingly, the aim of this study is to design and prioritize the productivity outcomes of fixed asset revaluation based on matrix-based analytical processes in the context of petrochemical companies.

1. Methods and Materials

The methodological framework of the present study can be explained based on three fundamental criteria, including the nature of the research outcome, the study objective, and the type of data. From the perspective of

research outcome, this study is classified as a developmental research, as it relies on its analytical nature and aims to conceptualize and systematically organize the phenomenon under investigation by designing a coherent framework that enhances the theoretical literature in accounting and finance regarding productivity outcomes of fixed asset revaluation. In terms of purpose, the study adopts an exploratory approach, seeking to identify and elaborate underexplored dimensions and components of the focal phenomenon, primarily through expert-based insights. Regarding the type of data, the study follows a mixed-methods design. In the qualitative phase, data were collected through in-depth and semi-structured interviews with experts and analyzed using grounded theory based on the emergent approach proposed by Glaser (1992). The sampling strategy was theoretical and followed a snowball procedure, ensuring that participants possessed sufficient expertise in accounting standards, financial reporting, and asset revaluation practices. The interviews continued until theoretical saturation was achieved, which occurred after fourteen interviews, where repetition of conceptual themes indicated that no new significant insights were emerging. In the quantitative phase, participants consisted of financial managers and heads of accounting departments within petrochemical companies, selected through purposive and convenience sampling. A total of twenty-two participants were included, consistent with methodological guidelines suggesting a sample size between 15 and 30 for matrix-based analytical techniques. Access to participants in this phase was facilitated through information gatekeepers to ensure the inclusion of knowledgeable and experienced respondents capable of contributing valid data aligned with the analytical objectives of the study.

Data collection in the qualitative phase was conducted through interviews designed to capture expert knowledge and experiential insights related to the productivity implications of fixed asset revaluation. The interview protocol was carefully structured yet flexible, allowing for adaptation based on the interview context and participant responses. Both unstructured (deep) and semi-structured (semi-deep) interviews were utilized to ensure comprehensive exploration of the phenomenon. The interviews were designed to facilitate the extraction of open codes, conceptual themes, and core components through iterative questioning and refinement of inquiry paths. In addition to interviews, the Delphi technique was employed in the second stage of the qualitative phase to refine and validate the extracted components. A seven-point Likert scale checklist was developed and distributed among experts to assess the relevance and coherence of conceptual themes with their corresponding core components. The evaluation criteria included measures such as mean scores and agreement coefficients to determine consensus among experts. This process ensured the content validity and internal consistency of the identified dimensions before proceeding to the quantitative phase. In the quantitative phase, data were collected using structured matrix-based checklists designed for pairwise comparison of the identified core components. These matrices enabled participants to evaluate the directional influence between components across different relational states, including row-to-column effects, column-to-row effects, mutual interactions, and absence of relationships.

The analytical process of the study was conducted in two distinct phases corresponding to the qualitative and quantitative components. In the qualitative phase, grounded theory analysis was implemented through three sequential coding stages, namely open coding, axial coding, and selective coding. Open coding involved the identification and extraction of initial codes from interview transcripts, resulting in a substantial pool of raw data. Axial coding was then employed to organize these codes into related categories and core components by identifying relationships and patterns among them. Throughout the interview process, coding was conducted iteratively, allowing the researcher to refine interview questions and guide subsequent data collection toward achieving theoretical saturation. Selective coding represented the final stage, wherein core components were integrated into

higher-level structural categories and aligned with existing theoretical frameworks where applicable, or labeled based on empirical insights derived from expert perspectives when theoretical support was limited. Following the qualitative analysis, the Delphi technique was applied to validate and refine the identified components through expert consensus, using predefined thresholds for mean scores and agreement coefficients to determine inclusion or exclusion of elements. In the quantitative phase, matrix-based analysis was conducted to prioritize the core components. A symmetric influence matrix was constructed to examine the relationships among components across four directional states, including direct influence from row to column, reverse influence from column to row, mutual influence, and absence of influence. By analyzing these relational patterns and calculating matrix-based scoring percentages, the study identified and ranked the most influential dimension among the productivity outcomes of fixed asset revaluation within the context of petrochemical companies. Additionally, the validity of the qualitative findings was ensured through triangulation, including member checking, peer review, audit trail documentation, and theoretical validation, thereby enhancing the reliability and transferability of the results to the study context.

2. Findings and Results

In order to explain the methodological processes of the study aimed at achieving a coherent theoretical framework for representing the productivity aspects of fixed asset revaluation, and by adhering to the implementation process of grounded theory analysis and the interview protocol model, a total of 14 interviews were conducted. Through the stages of open, axial, and selective coding, a total of 282 initial open codes were identified. Subsequently, to classify conceptual themes into components and components into categories, the results presented in Table (1) provide an initial report of the identified dimensions.

Table 1. Results of the Grounded Theory Analysis Process

Structural Categories	Operational Efficiency and Asset Management	Financial Capacity Efficiency and Capital Structure Improvement	Corporate Information Efficiency	Total
Core Components	Operational Capacity	Decision-Making Productivity	Liquidity Improvement	Financial Risk Reduction
Open Codes	33	35	37	32
Axial Codes	5	5	5	5
Percentage of Open Coding	15.94%	16.90%	17.87%	15.45%
Percentage of Axial Coding	16.67%	16.67%	16.67%	16.67%

As shown in Table (1), based on 207 open codes derived from the conducted interviews, 30 conceptual themes were identified, indicating that approximately 14.49% of each open code was transformed into a conceptual theme. Furthermore, by identifying 6 core components from the 30 conceptual themes, it can be inferred that 20% of each conceptual theme contributed to the formation of a core component, and for each structural category (three emerged categories), two core components were reorganized. These details regarding the coding process, alongside the distribution of open and axial coding percentages, justify the achievement of theoretical saturation. This is because, in order to determine the endpoint of interviews, it is essential to maintain a relative balance in the allocation of open codes to conceptual themes and subsequently to core components after each interview. Maintaining such balance ensures internal consistency and validity of the identified dimensions of the focal phenomenon. Accordingly, as themes began to repeat between the first to seventh interviews and subsequently between the eighth to fourteenth

interviews, the study proceeded to classify the number of open codes obtained from each interview and their corresponding frequency percentages.

Table 2. Distribution of Emergent Open Codes at the End of Each Interview

Interview No.	Number of Codes	Frequency (%)	Interview No.	Number of Codes	Frequency (%)
First Interview	28	13.46%	Eighth Interview	15	7.21%
Second Interview	26	12.50%	Ninth Interview	10	4.80%
Third Interview	24	11.53%	Tenth Interview	8	3.84%
Fourth Interview	23	11.05%	Eleventh Interview	6	2.88%
Fifth Interview	20	9.61%	Twelfth Interview	5	3.90%
Sixth Interview	18	8.65%	Thirteenth Interview	4	1.92%
Seventh Interview	17	8.17%	Fourteenth Interview	4	1.92%
Total Open Codes	156	75%	Total Open Codes	52	25%

As observed, for each conducted interview, the number of open codes identified after coding was specified, resulting in a total of 208 open codes at the point of theoretical saturation. This table also demonstrates that the emergence of open codes followed a gradual trend from the first interview to the final interviews. This trend reflects the elimination of redundancies and a stronger focus on the emergence of new codes, indicating a proper progression from open coding to axial and then selective coding.

Therefore, by clarifying the procedural trajectory of grounded theory implementation for identifying emerging aspects of the focal phenomenon, Table (3) presents the categorization of dimensions across different coding stages.

Table 3. Process of Classifying Identified Codes of the Focal Phenomenon During Interviews

Open Coding	Axial Coding	Selective Coding
Improving asset return measurement through more accurate valuation of productive assets	Asset Operational Capacity	Operational Efficiency and Asset Management
Improving underperforming or idle assets and enabling their disposal or replacement		
Improving planning for depreciation and maintenance costs	Strategic Decision-Making Mechanism	
Enhancing efficient utilization of asset capacity due to transparency of real economic value		
Improving information for strategic decisions regarding production line optimization or development		
Strengthening comprehensive fixed asset management planning based on current values		
Enhancing accuracy in cost-benefit analysis of long-term investment projects		
Strengthening company competitiveness through asset-based strategic decisions	Liquidity Improvement	Financial Capacity Efficiency and Capital Structure Improvement
Optimizing asset portfolio and capital allocation		
Strengthening long-term financial planning and preventing decisions based on outdated valuations	Financial Risk Reduction	
Increasing capacity to obtain bank financing through improved asset collateral value		
Increasing liquidity ratios and working capital due to improved financial bases		
Enhancing financing capacity for development projects		
Increasing conversion of revalued assets into financial instruments		
Increasing credit attractiveness for banks and institutional investors		
Improving debt-to-equity ratio through increased equity		
Enhancing leverage capability and stability in capital structure		
Improving compliance with Article 141 of Commercial Law through capital increase		

Enhancing loss absorption capacity without threatening continuity		
Improving credit rating and reducing cost of capital		
Enhancing quality of the information environment	Financial Information Reliability	Corporate Information Efficiency
Improving comparability of financial statements		
Strengthening faithful representation in disclosure		
Enhancing competitive advantages of financial statements		
Improving forecasting of future cash flows		
Aligning financial reporting with international valuation standards	Institutional Alignment	
Enhancing compliance with stock exchange and audit disclosure requirements		
Reducing audit ambiguity risks in asset valuation		
Facilitating risk assessment by regulatory bodies		
Standardizing valuation procedures and reducing accounting discrepancies		

Accordingly, to achieve the main objective of the qualitative phase of the study, and based on the identified conceptual themes, core components, and categories, the six-dimensional polygonal framework of productivity outcomes of fixed asset revaluation was developed.

Following the establishment of this framework, and to enhance convergence for explaining the core components in the quantitative phase, the identified conceptual themes were subjected to Delphi analysis. A seven-point Likert scale checklist was designed, using a mean threshold of 5.00 and an agreement coefficient threshold of 0.50 to determine the reliability of the identified criteria. The results of this process are presented in Table (4).

Table 4. Reliability Results of Conceptual Themes in Relation to Core Components (Delphi Analysis)

Core Component	Conceptual Theme	Mean (Round 1)	Agreement (Round 1)	Mean (Round 2)	Agreement (Round 2)	Accepted	Rejected
Asset Operational Capacity	Improving asset return measurement through accurate valuation	6.00	0.80	6.15	0.84	✓	-
	Improving underperforming or idle assets	6.20	0.85	6.30	0.88	✓	-
	Improving depreciation and maintenance planning	5.50	0.75	5.60	0.78	✓	-
	Enhancing asset utilization efficiency	5.30	0.65	5.50	0.75	✓	-
	Improving strategic decision information	5.10	0.55	5.20	0.60	✓	-
Strategic Decision-Making Mechanism	Strengthening asset management planning	5.30	0.65	5.50	0.75	✓	-
...	✓	-

All conceptual themes across components met the acceptance criteria based on the defined thresholds, indicating sufficient reliability and consensus among experts.

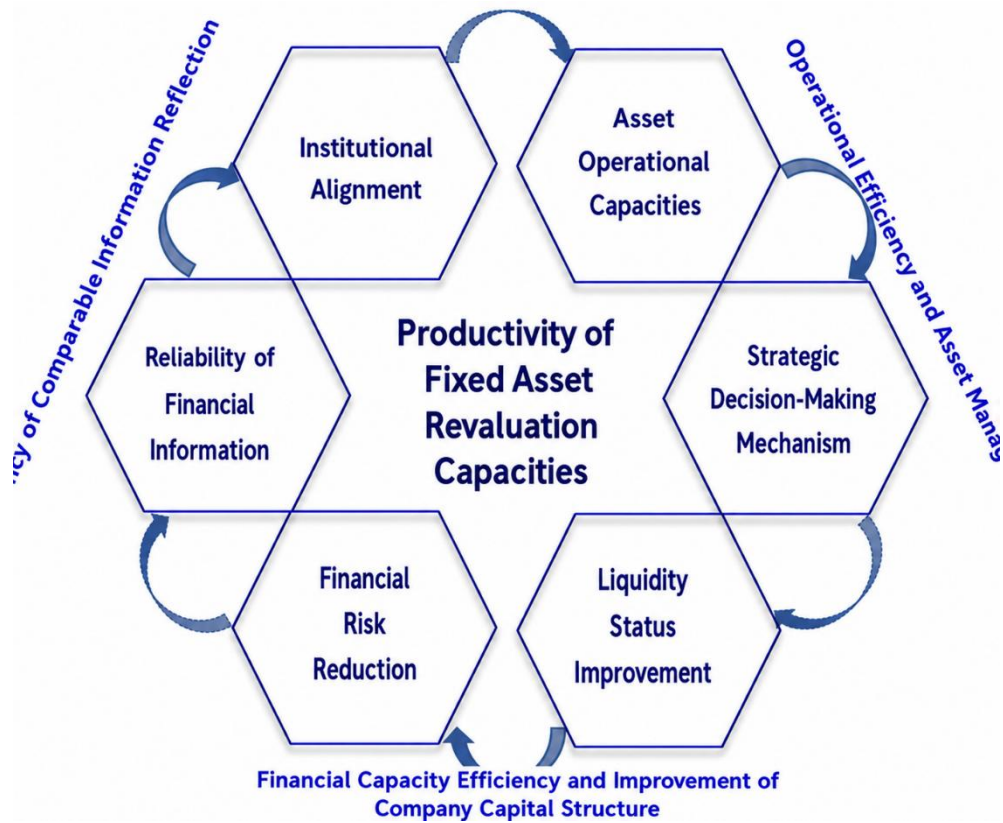


Figure 1. Conceptual Model

The results indicate that all conceptual themes were confirmed in relation to the core components based on the two criteria of mean and agreement coefficient. After confirming the main components of the study, fuzzy interpretive structural modeling (FISM) was conducted to select the most influential accounting component of the discourse. After identifying the main components of the study, this analysis first seeks to construct a self-interaction matrix by forming a pairwise comparison matrix through the participation of respondents in the quantitative phase of the study, using the codes “O,” “X,” “A,” and “V.” These expressions represent the possible types of relationships among the study components. In addition, the intensity of influence between two components is expressed through five linguistic scales: no influence, low influence, moderate influence, high influence, and very high influence:

- V*: Variable *i* influences variable *j* (low, moderate, high, very high).
- A*: Variable *j* influences variable *i* (low, moderate, high, very high).
- X*: Variables *i* and *j* influence each other (low, moderate, high, very high).
- O*: Factor *i* and factor *j* are unrelated.

Therefore, a process had to be designed so that the scores would be understandable in determining the level of influence as low, moderate, high, and very high. Accordingly, the following linguistic expressions were used.

Table 5. Linguistic Expressions, Corresponding Codes, Fuzzy Numbers, and Representation of Influence Intensity in the Model

Item	No Influence	Low Influence	Moderate Influence	High Influence	Very High Influence
Triangular fuzzy number	[0.00·0.00·0.25]	[0.00·0.25·0.50]	[0.25·0.50·0.75]	[0.50·0.75·1.00]	[0.75·1.00·1.00]
Abbreviation	<i>(NO)</i>	<i>(L)</i>	<i>(M)</i>	<i>(H)</i>	<i>(VH)</i>
Linguistic expression	No influence	Low influence	Moderate influence	High influence	Very high influence
Likert scale	[0]	[1]	[2]	[3]	[4]

Table 6. Method of Completing the Matrix Using Conceptual Symbols and Fuzzy Quantitative Numbers

Conceptual Symbol	Expert Response	Conceptual Symbol (<i>i</i> , <i>j</i>)	Fuzzy Symbol (<i>i</i> , <i>j</i>)	Conceptual Symbol (<i>j</i> , <i>i</i>)	Fuzzy Symbol (<i>j</i> , <i>i</i>)
V	V(VH): Variable <i>i</i> has a very high influence on <i>j</i> .	VH	(0.75, 1, 1)	NO	(0, 0, 0.25)
V	V(H): Variable <i>i</i> has a high influence on <i>j</i> .	H	(0.50, 0.75, 1)	NO	(0, 0, 0.25)
V	V(M): Variable <i>i</i> has a moderate influence on <i>j</i> .	M	(0.25, 0.50, 0.75)	NO	(0, 0, 0.25)
V	V(L): Variable <i>i</i> has a low influence on <i>j</i> .	L	(0, 0.25, 0.50)	NO	(0, 0, 0.25)
A	A(VH): Variable <i>j</i> has a very high influence on <i>i</i> .	NO	(0, 0, 0.25)	VH	(0.75, 1, 1)
A	A(H): Variable <i>j</i> has a high influence on <i>i</i> .	NO	(0, 0, 0.25)	H	(0.50, 0.75, 1)
A	A(M): Variable <i>j</i> has a moderate influence on <i>i</i> .	NO	(0, 0, 0.25)	M	(0.25, 0.50, 0.75)
A	A(L): Variable <i>j</i> has a low influence on <i>i</i> .	NO	(0, 0, 0.25)	L	(0, 0.25, 0.50)
X	X(VH)	VH	(0.75, 1, 1)	VH	(0.75, 1, 1)
X	X(H)	H	(0.50, 0.75, 1)	H	(0.50, 0.75, 1)
X	X(M)	M	(0.25, 0.50, 0.75)	M	(0.25, 0.50, 0.75)
X	X(L)	L	(0, 0.25, 0.50)	L	(0, 0.25, 0.50)
X	X(VH, M)*	VH	(0.75, 1, 1)	M	(0.25, 0.50, 0.75)
O	O(NO)	NO	(0, 0, 0.25)	NO	(0, 0, 0.25)

Variables with bidirectional relationships may have two relationships with different levels of influence. In this case, the first symbol represents the influence of factor *i* on *j*, and the second symbol represents the influence of *j* on *i*. The level of influence is recorded exactly in the corresponding row and column according to the expert's opinion. Thus, the pairwise comparison matrix becomes an $n \times n$ matrix as follows:

$$\tilde{D}_{ij}]_{n \times n} = \begin{bmatrix} p_1 & p_2 & \dots & p_n \\ p_1 & - & \tilde{d}_{12} & \dots & \tilde{d}_{1n} \\ p_2 & \tilde{d}_{21} & - & \dots & \tilde{d}_{2n} \\ \vdots & \vdots & \vdots & - & \vdots \\ p_n & \tilde{d}_{n1} & \tilde{d}_{n2} & \dots & - \end{bmatrix}$$

Considering that these types of checklists are less commonly used in research and because experts were unfamiliar with this form of questionnaire, the questionnaire was delivered to the experts in person, and the necessary explanations were provided to them. In the above matrix, p_i represents the *i*-th criterion, $\tilde{d}_{ij} = (l_{ij}, m_{ij}, u_{ij})$ indicates the extent to which the *i*-th criterion influences the *j*-th criterion, and l_{ij} , m_{ij} , and u_{ij} represent the lower, middle, and upper bounds of the triangular fuzzy number \tilde{d}_{ij} , respectively. It should be noted that randomizing the accounting components of the discourse prevents conceptual bias in interpreting the components. Finally, respondents also explained the reason for the existence of each influence relationship. Based on these codes, the initial self-interaction matrix is presented in Table (6).

Table 7. Structural Self-Interaction Matrix

Component	Code	B6	B5	B4	B3	B2	B1
Asset Operational Capacity	B1	A(H)	V(M)	V(VH)	A(H)	V(L)	⊗
Strategic Decision-Making Mechanism	B2	V(L)	O(NO)	O(NO)	A(VH)	⊗	
Liquidity Improvement	B3	V(VH)	O(NO)	O(NO)	⊗		
Financial Risk Reduction	B4	V(VH)	A(H)	⊗			
Financial Information Reliability	B5	B(VH, M)	⊗				
Institutional Alignment	B6	⊗					

After determining the conceptual relationships based on the modal proposition, the reachability matrix was formed. In other words, at this stage, by converting the relationship symbols of the structural matrix into zero and one values based on the following table, the reachability matrix can be developed.

Table 8. Formation of the Pairwise Comparison Matrix

Component	Code	B1	B2	B3	B4	B5	B6
Asset Operational Capacity	B1	(0·0·0)	(0.75·1·1)	(0·0·0.25)	(0.75·1·1)	(0.25·0.50·0.75)	(0.75·1·1)
Strategic Decision-Making Mechanism	B2	(0·0·0.25)	(0·0·0)	(0·0·0.25)	(0·0·0.25)	(0·0·0.25)	(0·0.25·0.50)
Liquidity Improvement	B3	(0.50·0.75·1)	(0.75·1·1)	(0·0·0)	(0·0·0.25)	(0·0·0.25)	(0.75·1·1)
Financial Risk Reduction	B4	(0·0·0.25)	(0·0·0.25)	(0·0·0.25)	(0·0·0)	(0·0·0.25)	(0.75·1·1)
Financial Information Reliability	B5	(0·0·0.25)	(0·0·0.25)	(0·0·0.25)	(0.50·0.75·1)	(0·0·0)	(0.75·1·1)
Institutional Alignment	B6	(0·0·0.25)	(0·0·0.25)	(0·0·0.25)	(0·0·0.25)	(0.25·0.50·0.75)	(0·0·0)

Then, to perform operations in the interpretive structural equations, it was necessary to aggregate the experts' opinions. Accordingly, the defuzzified matrix is presented in the following table.

Table 9. Defuzzified Matrix

Component	Code	B1	B2	B3	B4	B5	B6
Asset Operational Capacity	B1	0	0.025	0.017	0.0176	0.068	0.093
Strategic Decision-Making Mechanism	B2	0.020	0	0.015	0.016	0.028	0.022
Liquidity Improvement	B3	0.011	0.017	0	0.033	0.039	0.047
Financial Risk Reduction	B4	0.028	0.015	0.035	0	0.016	0.033
Financial Information Reliability	B5	0.019	0.016	0.052	0.019	0	0.046
Institutional Alignment	B6	0.036	0.021	0.049	0.022	0.018	0

After determining the threshold value, which was equal to 0.042, all defuzzified numbers in the matrix were compared one by one with the threshold. Elements equal to or greater than the threshold were assigned a value of 1, and values smaller than the threshold were assigned a value of 0. Thus, the initial reachability matrix is as follows:

Table 10. Initial Matrix

Component	Code	B1	B2	B3	B4	B5	B6
Asset Operational Capacity	B1	1	1	0	0	0	0
Strategic Decision-Making Mechanism	B2	0	1	0	0	1	0
Liquidity Improvement	B3	1	0	1	1	1	0
Financial Risk Reduction	B4	0	0	0	1	0	1
Financial Information Reliability	B5	1	1	0	1	1	1
Institutional Alignment	B6	0	0	1	0	0	1

Next, to determine the relationships among the propositions, the output set, input set, and common elements must first be identified. The level and priority score of the variables are determined by identifying the reachability set and antecedent set for each variable. The reachability set of each variable includes the variables that can be reached through that variable, while the antecedent set includes the variables through which that variable can be reached. Then, the intersections of the reachability and antecedent sets are determined for all factors. If the reachability set and the intersection set of a factor or factors are identical, that factor is considered as a priority level. Level refers to the layers designed in the final model. To obtain the remaining levels, the previous levels must be removed from the matrix, and the process must be repeated. After determining the levels, the received matrix is reordered according to the levels, and the new matrix is called the conical matrix. At this stage, using the final reachability matrix, the output and input sets are obtained for each variable. The output and input sets for a variable are defined as follows. The output set for a specific dimension/component includes the variable itself together with

other variables affected by it; in other words, the variables that can be reached through that variable. The input set for each variable includes the variable itself together with other variables that influence it. Finally, common elements refer to the shared dimensions of the output and input sets of variables in comprehensive interpretive structural modeling as high-level variables; in other words, these variables do not contribute to the creation of any other variable. After determining the output elements, input elements, and common elements, the proposition whose output elements and common elements are identical is identified as the first level and the least influential accounting component of the discourse. After determining this level, that is, the least influential accounting component of the discourse, the component is removed, and identical elements of the input and common sets are examined and selected as the next level. This operation is repeated until the constituent elements of all system levels are identified.

Table 11. Output Proposition Set, Input Proposition Set, and Common Elements of the Research Components

Component	Code	Output Proposition	Input Proposition	Common Elements	Effect-Level Ranking of Components
Asset Operational Capacity	B1	1, 2, 4, 5, 6	1, 3	1	V
Strategic Decision-Making Mechanism	B2	2, 6	1, 2, 3	2	IV
Liquidity Improvement	B3	1, 2, 3, 4	3, 6	3	III
Financial Risk Reduction	B4	4, 5, 6	1, 3, 4, 5	4, 5	II
Financial Information Reliability	B5	4, 5, 6	1, 4, 5, 6	4, 5, 6	I
Institutional Alignment	B6	3, 4, 5, 6	1, 2, 4, 5, 6	4, 5, 6	I

Based on the comparison of common elements and output propositions, it was determined that the component of asset operational capacity is the most central productivity outcome resulting from fixed asset revaluation in petrochemical companies.

3. Discussion and Conclusion

The findings of the present study provide a comprehensive and multidimensional understanding of the productivity outcomes associated with the revaluation of fixed assets, particularly within the context of petrochemical companies. The results indicate that among the identified core components, asset operational capacity emerged as the most central and influential dimension in the productivity outcomes of fixed asset revaluation. This suggests that revaluation practices primarily contribute to enhancing the efficiency and utilization of operational assets by providing more accurate and up-to-date information about their economic value. Such findings align with the theoretical premise that asset revaluation improves the quality of information available for operational planning and resource allocation, thereby enabling firms to optimize production processes and enhance efficiency. Prior studies have similarly emphasized the role of accurate asset valuation in improving operational performance and productivity dynamics, particularly through the lens of efficiency measurement frameworks such as the Malmquist index (9, 10). Moreover, the improved identification of underutilized or obsolete assets facilitates better asset management decisions, which ultimately contributes to enhanced operational efficiency and strategic resource deployment.

In addition to operational capacity, the results highlight the significant role of strategic decision-making mechanisms as a key component influenced by asset revaluation. The availability of more reliable and economically relevant asset information enables managers to make more informed decisions regarding investment, expansion,

and restructuring. This finding is consistent with the literature on strategic management and decision-making, which underscores the importance of high-quality financial information in enhancing organizational competitiveness and long-term planning. Studies employing structural modeling approaches have demonstrated that improved decision-making frameworks, supported by accurate data, significantly enhance firms' ability to achieve competitive advantage (13, 14). Furthermore, the integration of revalued asset information into strategic planning processes enhances the alignment between operational capabilities and long-term organizational objectives, thereby strengthening the overall effectiveness of managerial decisions.

The study also identifies liquidity improvement as a critical outcome of fixed asset revaluation. By increasing the book value of assets, firms are able to enhance their borrowing capacity and improve key financial ratios, which in turn facilitates access to external financing. This is particularly relevant in capital-intensive industries such as petrochemicals, where access to financial resources is crucial for sustaining operations and funding expansion projects. The findings support previous research indicating that asset-based financing and the availability of collateral play a significant role in enhancing firms' financial flexibility and resilience (7). Additionally, the improved liquidity position resulting from revaluation contributes to the stability of financial operations and reduces the likelihood of financial distress, thereby reinforcing the importance of revaluation as a tool for financial management.

Another important dimension identified in the study is the reduction of financial risks associated with asset revaluation. The findings suggest that revaluation contributes to improved leverage ratios, enhanced creditworthiness, and greater stability in capital structure. This is consistent with the literature on financial stability and risk management, which emphasizes the role of asset structure and valuation in mitigating financial risks and enhancing organizational resilience. For instance, research has shown that a well-structured asset base contributes to the stability of financial performance and reduces vulnerability to market fluctuations (8). Moreover, the improved transparency and reliability of financial information resulting from revaluation practices can reduce information asymmetry and enhance investor confidence, thereby contributing to lower cost of capital and improved market perception.

The findings further reveal that financial information reliability is a significant outcome of fixed asset revaluation. The adoption of fair value accounting and the alignment of asset values with market conditions enhance the relevance and comparability of financial statements. This improvement in information quality is critical for stakeholders, including investors, creditors, and regulators, who rely on accurate financial data for decision-making. The results are consistent with prior studies demonstrating that fair value accounting enhances the value relevance of financial information and improves the overall quality of financial reporting (4, 5). Additionally, the improved transparency associated with revaluation practices contributes to better corporate governance and accountability, thereby reinforcing the importance of high-quality financial reporting in modern financial systems.

Institutional alignment is another key component identified in the study, highlighting the role of regulatory compliance and adherence to accounting standards in shaping the outcomes of asset revaluation. The findings suggest that alignment with international financial reporting standards and regulatory requirements enhances the credibility and comparability of financial information, thereby facilitating integration into global capital markets. This is particularly relevant in the context of IFRS adoption, which has been shown to improve market efficiency and enhance investor confidence (2, 3). Furthermore, the institutional environment plays a crucial role in determining the effectiveness of revaluation practices, as strong governance frameworks and regulatory oversight are essential for ensuring the reliability and consistency of financial reporting.

The hierarchical analysis conducted using fuzzy interpretive structural modeling provides additional insights into the interrelationships among the identified components. The results indicate that asset operational capacity serves as a foundational driver influencing other components, while financial information reliability and institutional alignment occupy higher levels in the hierarchy, reflecting their role as outcomes rather than drivers. This hierarchical structure is consistent with the theoretical understanding of productivity systems, where operational efficiency and resource utilization serve as primary drivers of organizational performance, while information quality and institutional factors represent enabling conditions. Similar hierarchical relationships have been identified in previous studies using structural modeling approaches, which emphasize the interconnected nature of organizational variables and their collective impact on performance outcomes (23).

The results of this study also contribute to the broader literature on asset revaluation by providing a more nuanced understanding of its multidimensional productivity outcomes. While previous research has primarily focused on the financial and market-related implications of revaluation, the present study highlights the importance of considering operational, strategic, informational, and institutional dimensions in a unified framework. This integrated perspective is consistent with the concept of assetization, which emphasizes the role of assets as dynamic instruments of value creation and strategic management (1). Moreover, the findings support the argument that asset revaluation is not merely an accounting exercise but a strategic tool that can significantly influence organizational performance and competitiveness.

The study's findings are also aligned with empirical research examining the impact of asset revaluation on market outcomes and risk dynamics. For instance, the relationship between revaluation and stock price crash risk highlights the importance of financial competence and transparency in mitigating adverse market reactions (18). Similarly, the influence of fair value accounting on accounting conservatism underscores the complex interplay between valuation practices and financial reporting quality (19). These studies reinforce the notion that the benefits of asset revaluation are contingent on the broader institutional and organizational context, and that effective implementation requires a combination of technical expertise, regulatory compliance, and strategic alignment.

Despite its contributions, the present study has several limitations that should be acknowledged. First, the study is conducted within the specific context of petrochemical companies, which may limit the generalizability of the findings to other industries with different asset structures and operational characteristics. Second, the reliance on expert judgment in the qualitative phase and the use of matrix-based analytical techniques in the quantitative phase may introduce subjectivity and potential bias in the results. Third, the study focuses primarily on the internal organizational outcomes of asset revaluation and does not explicitly consider external market factors or macroeconomic conditions that may influence the effectiveness of revaluation practices.

Future research can build on the findings of this study by exploring the productivity outcomes of asset revaluation in different industrial contexts and across diverse economic environments. Comparative studies examining the impact of revaluation practices in developed and emerging markets could provide valuable insights into the role of institutional factors in shaping these outcomes. Additionally, future studies could incorporate longitudinal data to examine the dynamic effects of asset revaluation over time and to assess its long-term impact on organizational performance. The integration of advanced analytical techniques, such as machine learning and big data analytics, could also enhance the robustness and predictive power of future research in this area.

From a practical perspective, the findings of this study have important implications for managers, policymakers, and practitioners involved in financial reporting and asset management. Organizations should recognize the

strategic value of asset revaluation and integrate it into their broader decision-making and performance management frameworks. This includes investing in systems and processes that enhance the accuracy and reliability of asset valuation, as well as developing the necessary expertise to interpret and utilize revaluation data effectively. Policymakers and regulators should also consider the role of institutional frameworks in supporting the effective implementation of revaluation practices and in ensuring the transparency and comparability of financial information across firms and markets.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

All ethical principles were adhered in conducting and writing this article.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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