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Integrated Resource Management and Decision Engineering Model for Manufacturing Industries: A Hybrid Approach in Inflationary Economies

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ABSTRACT

This study aimed to design and validate an integrated resource management and decision engineering model for manufacturing industries operating under inflationary economic conditions. The study was conducted using an applied, descriptive-correlational, mixed-method design with a model-development orientation. The quantitative population consisted of managers and senior specialists working in manufacturing industries in Tehran, from which 312 participants were selected through purposive sampling. In the qualitative and decision-engineering phases, 18 academic and industrial experts participated. Data were collected using semi-structured expert interviews, a document review checklist, and a researcher-made Integrated Resource Management and Decision Engineering Questionnaire. Qualitative data were analyzed through thematic analysis, and quantitative data were analyzed using confirmatory factor analysis, structural equation modeling, mediation analysis, and expert-based decision-engineering prioritization. The measurement model showed acceptable reliability and validity, with factor loadings ranging from 0.67 to 0.89, Cronbach's alpha coefficients from 0.83 to 0.91, composite reliability values from 0.85 to 0.93, and average variance extracted values from 0.54 to 0.66. The structural model demonstrated acceptable fit indices, including $\chi^2/df = 2.31$, CFI = 0.942, TLI = 0.934, IFI = 0.943, RMSEA = 0.065, and SRMR = 0.051. Procurement and inventory resilience had the strongest effect on inflation risk assessment ($\beta = 0.29$, $p < 0.001$), followed by technological and data-driven decision support ($\beta = 0.26$, $p < 0.001$) and financial flexibility ($\beta = 0.24$, $p < 0.001$). Inflation risk assessment significantly predicted operational performance sustainability ($\beta = 0.41$, $p < 0.001$). The model explained 62% of the variance in inflation risk assessment and 68% of the variance in operational performance sustainability. The proposed hybrid model provides a valid framework for explaining how manufacturing firms can integrate strategic resources, financial flexibility, procurement resilience, technological decision support, and inflation risk assessment to sustain operational performance in inflationary economies.

Keywords: Integrated resource management; decision engineering; manufacturing industries; inflationary economies; operational performance sustainability; procurement resilience; structural equation modeling.

Introduction

Manufacturing industries operate at the intersection of resource transformation, market responsiveness, technological capability, and financial discipline. In stable economic environments, manufacturing firms can often rely on relatively predictable assumptions about input prices, supplier contracts, production capacity, inventory costs, and market demand. However, in inflationary economies, these assumptions become unstable, and

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managerial decisions must be made under conditions of cost volatility, purchasing power erosion, supplier uncertainty, capital constraints, and changing customer demand. Inflation affects not only the financial dimension of manufacturing but also the operational logic of production systems, because price instability influences procurement timing, inventory valuation, production scheduling, maintenance planning, pricing policies, and investment decisions. Evidence from macroeconomic and sectoral studies has shown that inflation can shape manufacturing performance by altering the relationship between production growth, industrial value added, and economic stability (1, 2). Therefore, manufacturing firms in inflationary contexts require more than traditional resource planning; they need integrated decision models capable of connecting financial, operational, technological, and strategic information into coherent managerial action.

The manufacturing sector is especially sensitive to inflation because it depends on continuous flows of raw materials, intermediate goods, energy, labor, technology, logistics, and working capital. When inflation accelerates, firms encounter higher replacement costs, increased uncertainty in procurement contracts, reduced reliability of price quotations, and difficulty in maintaining optimal inventory levels. These pressures are intensified when demand is also uncertain, because managers must decide whether to increase inventory before prices rise further or reduce stockholding to avoid excessive capital lock-in. Earlier production-inventory models have addressed inflation and time value of money as essential parameters in determining optimal policies for defective items, deteriorating items, shortages, and random demand (3, 4). These studies demonstrate that inflation is not an external background condition but a structural variable that changes the economic logic of production and inventory decisions.

Inflationary conditions also increase the importance of reliability, imperfect production, and demand-sensitive inventory systems. Manufacturing systems rarely operate under ideal assumptions; they face defective production, machine deterioration, uncertain quality levels, preservation costs, and changing demand rates. In this regard, models of imperfect production and reliability-dependent demand have emphasized that production reliability directly affects inventory performance and managerial decisions (5). Similarly, research on imperfect production under inflation has shown that demand, reliability, time effort, selling price, and fuzzy uncertainty should be considered together when determining optimal manufacturing and inventory policies (6, 7). These findings indicate that isolated decision rules are insufficient when firms operate in economic environments where both production systems and market conditions are unstable.

In addition to operational uncertainty, inflation places pressure on financial decision-making and dynamic pricing. Manufacturing firms must continuously balance procurement costs, inventory carrying costs, financing costs, revenue expectations, and adjustment costs. Dynamic pricing and inventory planning under inflation require managers to consider not only the current cost of resources but also expected future cost changes and the value of money over time (8). In this sense, inflation transforms production and resource management into an intertemporal decision problem. Managers are required to determine when to buy, when to produce, how much to store, how to price, and how to allocate limited capital among competing resource needs. This reinforces the necessity of decision engineering, because manufacturing decisions in inflationary economies involve multiple objectives, constraints, feedback loops, and uncertain future states.

The broader macroeconomic literature also suggests that inflation dynamics interact with monetary policy, industrial investment, and firm-level planning. While macroeconomic studies often examine inflation through monetary transmission, expectations, and price-setting behavior, manufacturing firms experience inflation through concrete operational problems such as cost escalation, reduced investment predictability, and pressure on production margins (9). In emerging and inflation-prone economies, these problems can become persistent rather than temporary. Therefore, firm-level resource management models must be designed in a way that translates macroeconomic uncertainty into operationally meaningful decision criteria. A manufacturing firm cannot control inflation, but it can improve how it anticipates inflationary shocks, allocates resources, protects production continuity, and maintains sustainable performance.

Recent studies in production planning have expanded this perspective by incorporating machine deterioration, maintenance timing, variable production rates, and time value of money into inflation-sensitive planning models (10). Such approaches are important because manufacturing performance depends not only on materials and inventories but also on the physical condition of machinery and the timing of maintenance interventions. Under inflationary pressure, delaying maintenance may appear financially attractive in the short term, yet it can increase the risk of production failure, quality loss, and future replacement costs. Consequently, integrated resource management must include financial flexibility, machine reliability, maintenance planning, and production adaptability as interconnected dimensions rather than separate managerial domains.

Another important development in the literature is the integration of sustainability, preservation investment, green technology, and multi-echelon supply chain structures into inventory and production models. In inflationary economies, sustainability-oriented investment can be difficult because firms may prioritize immediate cost survival over long-term ecological and operational goals. However, research has shown that green technology, preservation investment, and hybrid carbon policies can be incorporated into sustainable inventory and supply chain decisions even under inflationary conditions (11-13). These studies suggest that inflation-sensitive manufacturing decisions should not be limited to cost minimization; they must also consider sustainability, carbon responsibility, product deterioration, and supply chain coordination. This is particularly relevant for industries facing both economic instability and increasing pressure to adopt sustainable production practices.

The need for integrated models is further strengthened by the complexity of multi-item, multi-echelon, and hybrid demand systems. Manufacturing firms often manage multiple products, multiple suppliers, multiple warehouses, and multiple customer segments. In such environments, inflation affects each layer of decision-making differently. For example, one item may be highly sensitive to raw material price changes, while another may be more affected by customer demand elasticity or storage constraints. Research on joint replenishment strategies and deteriorating multi-item supply chains has highlighted the importance of coordinating production, inventory, replenishment, and uncertainty management in inflationary environments (11). Likewise, models addressing non-instantaneous deterioration, hybrid price- and stock-dependent demand, delayed payments, inflation, and customer returns show that real manufacturing and inventory systems involve interacting economic and behavioral conditions (14). These findings justify the development of hybrid approaches that combine quantitative modeling, expert judgment, and decision-support logic.

Beyond inventory and production planning, modern manufacturing increasingly depends on flexible, reconfigurable, and intelligent production systems. Reconfigurable manufacturing systems are designed to adapt to changes in product type, production volume, technology requirements, and market conditions. Such systems are highly relevant in inflationary economies because firms must respond quickly to material shortages, cost increases, demand shifts, and supplier instability. Research on reconfigurable manufacturing has emphasized the role of sustainability, circularity, responsiveness, and system adaptability in future production models (15, 16). Sustainable reconfigurable manufacturing systems allow firms to maintain performance by redesigning production configurations, reallocating resources, and improving operational flexibility rather than relying on fixed production assumptions.

The development of smart and self-reconfigurable manufacturing systems has also expanded the role of digital technologies in industrial decision-making. Smart manufacturing architectures enable firms to collect data, monitor production conditions, evaluate system performance, and reconfigure processes more efficiently (17). In inflationary economies, such capabilities are particularly valuable because decision-makers require timely information about costs, capacity, inventory, supplier performance, and production constraints. Digital decision support can reduce informational delay and improve the quality of managerial responses. However, technology alone is not sufficient; it must be embedded within a broader decision-engineering framework that connects data to managerial priorities, operational constraints, and performance outcomes.

Sustainability-oriented reconfigurable manufacturing has also been examined through green bill of materials and multi-disciplinary design perspectives. These approaches emphasize that sustainability must be incorporated into the architecture of manufacturing systems rather than treated as an external reporting requirement (18, 19). Under inflationary conditions, the sustainability challenge becomes more complex because resource scarcity, rising input costs, and capital limitations may discourage long-term investment. Nevertheless, sustainable resource management can improve resilience by reducing waste, improving material efficiency, and supporting more adaptive production configurations. Therefore, integrated resource management in manufacturing should consider sustainability not only as an environmental objective but also as a strategic capability for maintaining operational continuity under economic pressure.

Recent research has also highlighted the importance of responsive and sustainable reconfigurable manufacturing systems in achieving industrial adaptability. Responsive systems are able to detect changes in market or production conditions and adjust system configuration accordingly (20). Similarly, sustainable reconfigurable manufacturing system design has been approached through bi-objective optimization, where firms seek to balance economic and environmental performance (21). These developments are consistent with the logic of decision engineering because they require structured evaluation of trade-offs, objectives, constraints, and system-level consequences. In inflationary economies, such trade-offs become even more critical, as firms must decide whether to prioritize cost control, capacity utilization, sustainability, inventory protection, or technological investment.

The system perspective on sustainable manufacturing further emphasizes that intelligent and reconfigurable production processes should be understood as interconnected systems rather than isolated technologies. Sustainable manufacturing through intelligent systems involves the integration of production processes, resource flows, digital tools, and strategic objectives (22). A longitudinal view of reconfigurable manufacturing system development also shows that the transition from design to full-scale production requires continuous learning, adaptation, and alignment among technical and organizational elements (23). These insights are important for the present study because manufacturing firms in inflationary economies need models that are not only statistically valid but also practically capable of supporting gradual organizational implementation.

Decision engineering provides a methodological foundation for structuring such complex industrial problems. Decision-making in systems engineering and management emphasizes the formal analysis of objectives, alternatives, uncertainty, risk, stakeholder preferences, and system consequences (24). In manufacturing industries, decision engineering can be used to translate complex operational realities into structured models that support prioritization, causal mapping, and evidence-based managerial intervention. This is especially important when inflation creates multidimensional uncertainty and when managers must make decisions that simultaneously affect finance, procurement, production, inventory, human resources, technology, and market coordination. A hybrid decision-engineering approach can therefore bridge the gap between analytical modeling and practical managerial judgment.

The integration of production planning and warehouse allocation further illustrates the need to combine operational decisions that are often studied separately. Manufacturing firms must determine not only what and how much to produce but also where and how resources and items should be allocated across warehouses, production lines, and storage systems (25). Under inflationary conditions, location allocation and warehouse planning become more important because inventory placement influences accessibility, transportation cost, stockout risk, and working capital efficiency. Therefore, an integrated resource management model should include production planning adaptability, procurement and inventory resilience, supplier coordination, and cost-control capability as interconnected constructs.

Despite the richness of the literature, several gaps remain. Many existing studies provide mathematical production-inventory models under inflation, while others focus on reconfigurable manufacturing, sustainability, or decision-support systems. However, fewer studies integrate these streams into a unified managerial model that can be empirically validated in manufacturing industries operating under inflationary conditions. Production-inventory studies have made substantial contributions by modeling deterioration, imperfect production, reliability, preservation, and time value of money (26, 27). Reconfigurable manufacturing studies have contributed important insights into flexibility, sustainability, and intelligent adaptation (20, 23). Yet manufacturing managers still need an applied model that explains how strategic resource alignment, financial flexibility, procurement resilience, technological decision support, inflation risk assessment, and cost-control capability jointly influence operational performance sustainability.

The present study responds to this need by proposing a hybrid model that combines integrated resource management and decision engineering for manufacturing industries in inflationary economies. Such a model is particularly relevant for manufacturing firms in Tehran, where industrial managers often face unstable input prices, supply constraints, financing limitations, demand fluctuations, and pressure to maintain production continuity. By examining both the measurement structure and the causal relationships among key constructs, the study seeks to provide a model that is theoretically grounded, empirically testable, and practically useful for industrial decision-makers. The aim of this study was to design and validate an integrated resource management and decision engineering model for manufacturing industries in inflationary economies.

Methods and Materials

The present study was conducted using an applied, descriptive-correlational, and mixed-method research design with a model-development orientation. The study aimed to design and validate an integrated resource management and decision engineering model for manufacturing industries operating under inflationary economic conditions. The methodological logic of the study was hybrid because it combined expert-based qualitative model development, quantitative survey-based validation, and decision-engineering techniques for prioritizing and structuring the components of the proposed model. The statistical population consisted of managers, senior specialists, and decision-makers working in manufacturing industries located in Tehran, including firms active in food production, pharmaceuticals, chemicals, automotive parts, household appliances, metal products, textile production, and packaging industries. These participants were selected because they were directly involved in strategic resource allocation, production planning, supply chain coordination, financial decision-making, procurement, pricing, inventory management, and operational control under inflationary uncertainty.

The quantitative sample included 312 managers and senior experts from manufacturing firms in Tehran. Participants were selected through purposive sampling followed by proportional access to different manufacturing sectors to ensure that the sample reflected the diversity of industrial activities in Tehran. The inclusion criteria were having at least five years of professional experience in manufacturing industries, direct involvement in managerial or technical decision-making, familiarity with resource planning processes, and experience in dealing with inflation-related challenges such as price volatility, procurement risk, working capital pressure, production cost fluctuations, and uncertainty in supplier contracts. Participants who provided incomplete questionnaires or did not have sufficient professional experience in resource management or industrial decision-making were excluded from the final analysis. In addition to the quantitative sample, 18 experts participated in the qualitative and decision-engineering phases of the study. These experts included university faculty members in industrial management, operations research, supply chain management, and industrial engineering, as well as senior executives and consultants with extensive experience in manufacturing strategy and inflation-sensitive resource planning. The expert panel was used to identify, refine, and validate the dimensions of the model and to determine the causal and priority relationships among its components.

Data were collected using a combination of a semi-structured expert interview protocol, a document review checklist, and a researcher-made questionnaire developed specifically for the present study. The semi-structured interview protocol was designed to explore the main challenges, decision criteria, resource constraints, and adaptive strategies used by manufacturing firms under inflationary conditions. The interview questions focused on issues such as financial resource allocation, procurement instability, inventory control, production capacity adjustment, human resource flexibility, supplier relationship management, cost forecasting, technology use in decision-making, and managerial responses to economic uncertainty. The interviews were conducted with the 18 selected experts and continued until theoretical saturation was reached. The content obtained from the interviews was used to extract the preliminary components of the integrated resource management and decision engineering model.

The document review checklist was used to examine organizational and managerial evidence related to resource planning and decision-making in manufacturing firms. The reviewed materials included internal planning forms, production scheduling documents, procurement and inventory procedures, cost-control reports, budgeting practices, supplier evaluation criteria, and strategic planning documents that were made available by participating firms. This tool helped the researchers compare the statements of experts and managers with actual industrial practices and identify the operational indicators that should be included in the final model. The checklist was organized around the major domains of financial resources, material resources, human resources, technological resources, production capacity, supply chain coordination, inflation risk management, and decision-support mechanisms.

The main quantitative instrument was the Integrated Resource Management and Decision Engineering Questionnaire, which was developed by the researchers based on the qualitative findings, theoretical foundations of resource-based management, decision engineering, operations management, and inflation-sensitive industrial planning. The questionnaire consisted of 68 items scored on a five-point Likert scale ranging from strongly disagree to strongly agree. The instrument measured the major dimensions of the proposed model, including strategic resource alignment, financial flexibility, procurement and inventory resilience, production planning adaptability, human resource utilization, technological and data-driven decision support, supplier and market coordination, inflation risk assessment, cost-control capability, and operational performance sustainability. Higher scores indicated a stronger presence of integrated resource management capability and more advanced decision-engineering practices in the manufacturing firm. The face and content validity of the questionnaire were reviewed by 10 academic and industry experts. After expert review, ambiguous items were revised, overlapping items were removed, and the final version was approved for field administration. The reliability of the questionnaire was assessed through a pilot study with 30 managers from manufacturing firms similar to the main sample. Cronbach's alpha coefficients for the main dimensions were all above the acceptable threshold, indicating satisfactory internal consistency. Composite reliability and average variance extracted were also examined during the measurement model assessment to confirm the reliability and convergent validity of the constructs.

Data analysis was performed in several consecutive stages in accordance with the hybrid nature of the study. In the qualitative phase, the interview data were transcribed, reviewed, and analyzed using thematic analysis. Initial codes were extracted from expert statements, similar codes were grouped into subthemes, and the subthemes were then organized into broader dimensions representing the key components of integrated resource management and decision engineering in manufacturing industries. To increase the credibility of the qualitative findings, the extracted themes were reviewed by members of the expert panel, and revisions were made based on their feedback. The results of the qualitative phase provided the conceptual foundation for constructing the questionnaire and developing the initial research model.

In the quantitative phase, the data obtained from the 312 completed questionnaires were analyzed using descriptive and inferential statistical techniques. First, the data were screened for missing values, outliers, normality, and response consistency. Descriptive statistics, including mean, standard deviation, frequency, and percentage, were used to describe the demographic and organizational characteristics of the participants and to summarize the status of the main research variables. The reliability of the instrument was evaluated using Cronbach's alpha and composite reliability. Convergent validity was assessed through factor loadings and average variance extracted, while discriminant validity was examined by comparing the relationships among latent constructs. Confirmatory factor analysis was used to test the measurement model and determine whether the observed indicators adequately represented the latent dimensions of the proposed model.

Structural equation modeling was used to validate the relationships among the main constructs of the integrated model. The structural model examined how strategic resource alignment, financial flexibility, procurement and inventory resilience, technological decision support, production planning adaptability, and inflation risk management predicted sustainable operational performance in manufacturing firms. Model fit was evaluated using common fit indices, and the significance of direct, indirect, and total effects was assessed. In addition, decision-engineering techniques were applied to determine the relative importance and causal structure of the model components. Expert judgments were analyzed to identify the most influential dimensions and to prioritize the decision criteria relevant to manufacturing firms in inflationary economies. The integration of statistical modeling and decision-engineering analysis made it possible to both validate the conceptual model empirically and provide a practical prioritization framework for managers. All quantitative analyses were conducted using specialized statistical and decision-analysis software, and the significance level was set at 0.05.

Findings and Results

The demographic profile of the participants indicated that the final quantitative sample consisted of 312 managers and senior specialists working in manufacturing industries located in Tehran. Of these participants, 207 individuals were male and 105 individuals were female, representing 66.35% and 33.65% of the sample, respectively. In terms of age, 91 participants were between 30 and 39 years old, 142 participants were between 40 and 49 years old, and 79 participants were 50 years old or above, showing that most respondents were professionally mature and had sufficient managerial or technical experience in industrial decision-making. Regarding educational level, 84 participants held a bachelor's degree, 172 participants held a master's degree, and 56 participants held a doctoral degree. In terms of work experience, 76 participants had between 5 and 10 years of experience, 104 participants had between 11 and 15 years of experience, 88 participants had between 16 and 20 years of experience, and 44 participants had more than 20 years of experience in manufacturing-related activities. The occupational distribution of the respondents showed that 64 participants were production managers, 57 were procurement and supply chain managers or specialists, 49 were financial and cost-control managers, 61 were operations and production planning specialists, 43 were quality control and industrial engineering specialists, and 38 were senior executives, plant managers, or strategic decision-makers. The participating firms were active in different manufacturing sectors, including automotive parts, food production, pharmaceuticals, chemicals, household appliances, metal products, textiles, and packaging industries. This distribution confirmed that the data were obtained from participants who had direct and practical involvement in resource allocation, production planning, procurement, cost management, and strategic decision-making under inflationary economic conditions.

Table 1. Descriptive statistics of the main research variables

Variable	Mean	Standard Deviation	Minimum	Maximum	Skewness	Kurtosis
Strategic resource alignment	3.76	0.61	2.10	4.95	-0.42	0.31
Financial flexibility	3.48	0.68	1.85	4.90	-0.28	-0.14
Procurement and inventory resilience	3.54	0.66	1.95	4.88	-0.35	0.09
Production planning adaptability	3.62	0.63	2.05	4.94	-0.39	0.22
Human resource utilization	3.41	0.71	1.72	4.86	-0.21	-0.27
Technological and data-driven decision support	3.37	0.74	1.60	4.92	-0.18	-0.33
Supplier and market coordination	3.46	0.69	1.84	4.87	-0.24	-0.19
Inflation risk assessment	3.32	0.73	1.70	4.84	-0.16	-0.41
Cost-control capability	3.58	0.64	2.00	4.91	-0.37	0.15
Operational performance sustainability	3.51	0.67	1.92	4.89	-0.31	-0.08
Total integrated resource management and decision engineering score	3.51	0.59	2.06	4.83	-0.29	0.12

The descriptive findings presented in Table 1 show that the mean scores of the main variables were above the theoretical midpoint of the scale, indicating that manufacturing firms in Tehran had relatively moderate to favorable conditions in most dimensions of integrated resource management and decision engineering. Strategic resource alignment obtained the highest mean score, suggesting that participants perceived the alignment of financial, material, human, technological, and operational resources with organizational priorities as one of the strongest aspects of manufacturing management under inflationary conditions. Production planning adaptability and cost-control capability also received relatively high mean scores, indicating that many firms had developed practical mechanisms for revising production schedules, controlling costs, and adjusting operational decisions in response to price fluctuations and resource constraints. In contrast, inflation risk assessment and technological and data-driven decision support obtained the lowest mean scores among the studied variables. This finding indicates that although firms had experience in coping with inflationary pressures, their systematic use of forecasting tools, data analytics, scenario planning, and formal risk assessment remained less developed than their operational and managerial practices. The skewness and kurtosis values of all variables were within the acceptable range, showing that the distribution of the research variables did not substantially deviate from normality and that the data were suitable for subsequent multivariate analysis.

Table 2. Measurement model, reliability, and convergent validity indicators

Construct	Number of Items	Standardized Factor Loading Range	Cronbach's Alpha	Composite Reliability	Average Variance Extracted
Strategic resource alignment	7	0.71–0.86	0.88	0.90	0.61
Financial flexibility	6	0.69–0.84	0.86	0.88	0.58
Procurement and inventory resilience	7	0.70–0.87	0.89	0.91	0.63
Production planning adaptability	6	0.68–0.85	0.85	0.87	0.56
Human resource utilization	6	0.67–0.82	0.83	0.85	0.54
Technological and data-driven decision support	7	0.72–0.88	0.90	0.92	0.64
Supplier and market coordination	6	0.69–0.83	0.84	0.86	0.55
Inflation risk assessment	7	0.71–0.89	0.91	0.93	0.66
Cost-control capability	6	0.70–0.86	0.87	0.89	0.59
Operational performance sustainability	6	0.73–0.88	0.90	0.92	0.65
Total questionnaire	68	0.67–0.89	0.95	0.96	0.61

The results of the measurement model in Table 2 confirmed the adequacy of the research instrument for assessing the dimensions of the proposed model. The standardized factor loadings for all observed indicators were higher than 0.67, showing that the questionnaire items had acceptable explanatory power for their corresponding latent constructs. Cronbach's alpha values ranged from 0.83 to 0.91 for the main constructs, while the alpha coefficient for the total questionnaire was 0.95. These values indicate strong internal consistency and confirm that the items of each dimension measured a coherent conceptual domain. Composite reliability values ranged from 0.85 to 0.93 for the constructs and reached 0.96 for the total instrument, which further supports the reliability of the measurement model. The average variance extracted values were also above the acceptable threshold for all constructs, ranging from 0.54 to 0.66. This result indicates that each latent construct explained a sufficient proportion of the variance of its observed indicators. Overall, the reliability and convergent validity findings showed that the measurement model was statistically acceptable and that the developed instrument was suitable for evaluating integrated resource management and decision engineering in manufacturing industries under inflationary economic conditions.

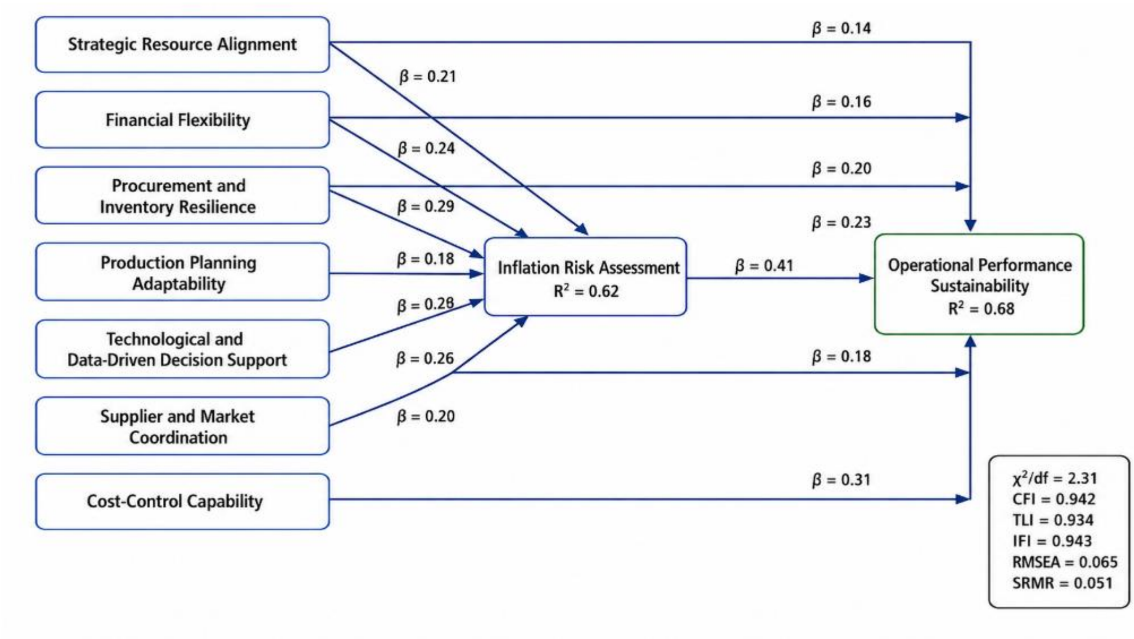

Figure 1. Final structural model of integrated resource management and decision engineering for manufacturing industries in inflationary economies

The final structural model indicated that the proposed hybrid model had acceptable empirical fit and could explain the relationships among resource management capabilities, inflation-sensitive decision processes, and sustainable operational performance. The model fit indices supported the adequacy of the proposed structure, with $\chi^2/df = 2.31$, comparative fit index = 0.942, Tucker–Lewis index = 0.934, incremental fit index = 0.943, root mean square error of approximation = 0.065, and standardized root mean square residual = 0.051. These values showed that the hypothesized model was consistent with the observed data and that the proposed relationships among the constructs were statistically defensible. The model demonstrated that strategic resource alignment, financial flexibility, procurement and inventory resilience, production planning adaptability, technological decision support, and supplier and market coordination contributed to inflation risk assessment and management. Inflation risk assessment, in turn, acted as a central mechanism through which managerial and operational resources were translated into sustainable operational performance. The structure of the model therefore confirmed that manufacturing firms operating in inflationary economies cannot rely only on isolated cost-control or procurement strategies; rather, they require an integrated decision architecture in which financial, operational, technological, and market-related information are continuously connected to managerial decision-making.

Table 3. Structural equation modeling results for the direct effects among model constructs

Structural Path	Unstandardized Coefficient	Standard Error	Standardized Coefficient	t-value	p-value	Result
Strategic resource alignment → Inflation risk assessment	0.24	0.06	0.21	4.00	<0.001	Supported
Financial flexibility → Inflation risk assessment	0.29	0.07	0.24	4.14	<0.001	Supported
Procurement and inventory resilience → Inflation risk assessment	0.33	0.06	0.29	5.50	<0.001	Supported
Production planning adaptability → Inflation risk assessment	0.20	0.06	0.18	3.33	0.001	Supported
Technological and data-driven decision support → Inflation risk assessment	0.31	0.07	0.26	4.43	<0.001	Supported
Supplier and market coordination → Inflation risk assessment	0.23	0.06	0.20	3.83	<0.001	Supported

Inflation risk assessment → Operational performance sustainability	0.42	0.07	0.41	6.00	<0.001	Supported
Cost-control capability → Operational performance sustainability	0.35	0.06	0.31	5.83	<0.001	Supported
Production planning adaptability → Operational performance sustainability	0.27	0.07	0.23	3.86	<0.001	Supported
Procurement and inventory resilience → Operational performance sustainability	0.24	0.07	0.20	3.43	0.001	Supported
Technological and data-driven decision support → Operational performance sustainability	0.21	0.06	0.18	3.50	<0.001	Supported
Financial flexibility → Operational performance sustainability	0.18	0.06	0.16	3.00	0.003	Supported
Strategic resource alignment → Operational performance sustainability	0.16	0.06	0.14	2.67	0.008	Supported

The structural equation modeling results presented in Table 3 show that all proposed direct paths were statistically significant. Among the predictors of inflation risk assessment, procurement and inventory resilience had the strongest standardized effect, indicating that the ability of manufacturing firms to manage raw material availability, supplier instability, inventory levels, purchasing timing, and replacement cost uncertainty was the most powerful contributor to inflation-sensitive decision-making. Technological and data-driven decision support also had a strong positive effect on inflation risk assessment, showing that firms with more developed information systems, forecasting tools, cost-tracking mechanisms, and analytical decision-support processes were better able to identify inflationary threats and adjust managerial decisions accordingly. Financial flexibility had a meaningful effect on inflation risk assessment, suggesting that access to flexible budgeting, liquidity planning, working capital control, and alternative financing mechanisms helped firms respond more effectively to inflation-induced uncertainty. Strategic resource alignment, production planning adaptability, and supplier and market coordination were also significant predictors, confirming that inflation risk management is strengthened when organizational resources, production decisions, supplier relations, and market information are integrated rather than managed separately. The results also showed that inflation risk assessment had the strongest direct effect on operational performance sustainability. This means that the more systematically firms assessed and managed inflation-related risks, the more likely they were to maintain production continuity, cost stability, delivery reliability, and performance sustainability. Cost-control capability was the second strongest predictor of operational performance sustainability, followed by production planning adaptability, procurement and inventory resilience, technological decision support, financial flexibility, and strategic resource alignment. The model explained 62% of the variance in inflation risk assessment and 68% of the variance in operational performance sustainability, indicating strong explanatory power for the proposed integrated model.

Table 4. Indirect effects of resource management capabilities on operational performance sustainability through inflation risk assessment

Indirect Path	Indirect Effect	Standard Error	Lower Confidence Bound	Upper Confidence Bound	p-value	Interpretation
Strategic resource alignment → Inflation risk assessment → Operational performance sustainability	0.086	0.024	0.041	0.139	<0.001	Significant mediation
Financial flexibility → Inflation risk assessment → Operational performance sustainability	0.098	0.027	0.049	0.156	<0.001	Significant mediation

Procurement and inventory resilience → Inflation risk assessment → Operational performance sustainability	0.119	0.030	0.064	0.184	<0.001	Significant mediation
Production planning adaptability → Inflation risk assessment → Operational performance sustainability	0.074	0.023	0.033	0.126	0.001	Significant mediation
Technological and data-driven decision support → Inflation risk assessment → Operational performance sustainability	0.107	0.029	0.054	0.169	<0.001	Significant mediation
Supplier and market coordination → Inflation risk assessment → Operational performance sustainability	0.082	0.025	0.037	0.135	0.001	Significant mediation

The mediation results in Table 4 confirmed that inflation risk assessment played a significant mediating role in the relationship between resource management capabilities and operational performance sustainability. The strongest indirect effect belonged to the path from procurement and inventory resilience to operational performance sustainability through inflation risk assessment. This result indicates that procurement and inventory systems improve operational performance not only through direct operational control but also by enhancing the firm's ability to recognize, evaluate, and manage inflation-related risks. In inflationary economies, manufacturing firms frequently face uncertainty in material prices, supplier commitments, import costs, transportation expenses, and replacement values. Therefore, firms that develop resilient procurement and inventory practices are better positioned to anticipate inflationary shocks and prevent disruptions in production continuity. The second strongest indirect effect was observed for technological and data-driven decision support, showing that analytical systems, digital dashboards, cost information systems, and forecasting tools strengthen performance sustainability by improving inflation risk assessment. Financial flexibility also had a meaningful indirect effect, indicating that budgetary adaptability and liquidity management support sustainable performance by enabling timely responses to cost increases and market instability. Strategic resource alignment, supplier and market coordination, and production planning adaptability also demonstrated significant mediated effects. These findings show that inflation risk assessment is not an isolated function but a central decision mechanism that connects different managerial capabilities to sustainable operational outcomes.

Table 5. Expert-based decision-engineering prioritization of the final model components

Component	Prominence Index	Causal Index	Normalized Weight	Priority Rank	Systemic Role
Strategic resource alignment	12.84	1.42	0.137	1	Cause factor
Technological and data-driven decision support	12.21	1.08	0.128	2	Cause factor
Financial flexibility	11.76	0.72	0.119	3	Cause factor
Inflation risk assessment	11.34	0.38	0.113	4	Cause factor
Procurement and inventory resilience	10.92	0.21	0.107	5	Cause factor
Cost-control capability	10.41	-0.28	0.101	6	Effect factor
Production planning adaptability	9.88	-0.34	0.095	7	Effect factor
Supplier and market coordination	9.43	-0.46	0.087	8	Effect factor
Human resource utilization	8.75	-0.71	0.062	9	Effect factor
Operational performance sustainability	8.16	-2.02	0.051	10	Outcome factor

The decision-engineering findings presented in Table 5 show the relative priority and causal position of the final model components based on expert judgments. Strategic resource alignment received the highest normalized weight and the strongest causal position, indicating that it functions as the primary driving component of the integrated model. This result means that in inflationary economies, manufacturing firms first need to align their financial, human, technological, material, and production resources with strategic priorities before separate operational improvements can produce sustainable results. Technological and data-driven decision support ranked second and was also identified as a strong cause factor. This finding demonstrates that decision quality in inflationary environments depends heavily on access to accurate, timely, and integrated information. Financial flexibility ranked third, confirming the central importance of liquidity control, flexible budgeting, working capital planning, and alternative financial responses in conditions of price instability. Inflation risk assessment and procurement and inventory resilience were also located in the cause group, showing that these components actively influence other elements of the system rather than merely reflecting their outcomes. Cost-control capability, production planning adaptability, supplier and market coordination, and human resource utilization were positioned in the effect group, meaning that they are influenced by the stronger cause factors but still contribute meaningfully to the operational functioning of the model. Operational performance sustainability had the lowest causal index and was identified as the final outcome factor, which is theoretically consistent with the logic of the model. These findings indicate that sustainable operational performance is the result of a chain of integrated managerial and decision-engineering capabilities rather than a single isolated managerial action. The expert agreement index was satisfactory, and the consistency of expert judgments supported the reliability of the prioritization process. Overall, the decision-engineering results confirmed that the most effective managerial interventions should begin with strategic alignment, technological decision support, financial flexibility, inflation risk assessment, and procurement resilience, because these components have the greatest systemic influence on the performance of manufacturing firms under inflationary conditions.

Discussion and Conclusion

The findings of the present study confirmed the empirical adequacy of the proposed integrated resource management and decision engineering model for manufacturing industries operating in inflationary economies. The descriptive results showed that the participating manufacturing firms had relatively moderate to favorable conditions in strategic resource alignment, production planning adaptability, cost-control capability, procurement and inventory resilience, and operational performance sustainability. However, inflation risk assessment and technological and data-driven decision support obtained comparatively lower mean scores. This pattern suggests that although manufacturing firms in Tehran have developed practical and experience-based responses to inflationary pressures, their formal decision-support systems, forecasting mechanisms, and systematic risk assessment capabilities remain less mature. This result is consistent with the literature emphasizing that inflation changes the operational and financial logic of production systems and forces firms to move beyond routine planning toward more analytical, integrated, and forward-looking decision models (1, 2). In other words, the results indicate that many firms may be able to cope with inflation through managerial experience, cost-control habits, and procurement adjustments, but sustainable performance under inflationary instability requires a more structured decision-engineering architecture.

The reliability and validity findings confirmed that the developed instrument had acceptable psychometric quality for measuring the dimensions of integrated resource management and decision engineering. The high factor loadings, Cronbach’s alpha coefficients, composite reliability values, and average variance extracted values demonstrated that the constructs of strategic resource alignment, financial flexibility, procurement and inventory resilience, production planning adaptability, technological decision support, inflation risk assessment, cost-control capability, and operational performance sustainability were empirically distinguishable yet conceptually connected.

This finding supports the theoretical assumption that manufacturing performance in inflationary economies is multidimensional and cannot be explained through a single operational indicator. Previous production-inventory studies have similarly shown that inflation must be modeled together with time value of money, deterioration, defective production, shortages, reliability, and demand uncertainty, because these factors jointly determine the behavior of manufacturing and inventory systems (3, 4, 6). Therefore, the validated measurement structure of the present study is aligned with prior evidence indicating that inflation-sensitive manufacturing requires an integrated rather than fragmented analytical framework.

The structural equation modeling results showed that procurement and inventory resilience had the strongest direct effect on inflation risk assessment. This finding indicates that manufacturing firms are better able to assess and manage inflationary risk when they possess resilient systems for raw material procurement, inventory control, supplier substitution, stock-level adjustment, and purchasing-time decisions. In inflationary economies, procurement and inventory decisions become strategically important because rising replacement costs, supplier uncertainty, and fluctuating market prices can directly disrupt production continuity. This result is strongly supported by prior studies on imperfect production and inventory models under inflation, which have shown that production reliability, selling price-dependent demand, fuzzy uncertainty, deteriorating items, and inflationary time value of money significantly affect optimal inventory decisions (5, 7, 26). It is also compatible with research on multi-echelon and joint replenishment systems, where coordinated inventory decisions are presented as essential for managing uncertainty and maintaining supply chain performance under inflationary conditions (11, 12).

The significant effect of technological and data-driven decision support on inflation risk assessment was another important result. This finding shows that manufacturing firms with stronger digital information systems, cost-monitoring tools, forecasting capabilities, and analytical decision-support mechanisms are more capable of identifying inflation-related threats and transforming uncertain economic signals into actionable managerial decisions. This result is aligned with studies on smart, self-reconfigurable, and intelligent manufacturing systems, which emphasize that manufacturing adaptability depends on the ability to collect, process, and use operational information in real time (17, 22). Similarly, studies on reconfigurable manufacturing systems suggest that responsiveness and sustainability require integrated information flows, system-level visibility, and the capacity to reconfigure production resources according to environmental changes (20, 23). Accordingly, the present finding confirms that inflation risk assessment is not only a financial activity but also a data-dependent managerial capability.

Financial flexibility also had a significant positive effect on inflation risk assessment and operational performance sustainability. This result suggests that firms with flexible budgeting, stronger liquidity management, adaptive working capital policies, and alternative financing options are better positioned to respond to cost increases and market instability. Under inflationary conditions, fixed financial assumptions quickly become obsolete, and firms must revise procurement budgets, production costs, pricing decisions, and investment priorities. This interpretation is consistent with studies indicating that inflation affects dynamic pricing, inventory planning, adjustment costs, and revenue expectations (8). It also aligns with the broader macroeconomic literature showing that inflation dynamics influence industrial performance, monetary conditions, and investment behavior (9). Therefore, financial flexibility should be understood as a central element of inflation-sensitive resource management rather than a supporting administrative function.

The results further demonstrated that inflation risk assessment was the strongest direct predictor of operational performance sustainability. This finding means that manufacturing firms are more likely to maintain production continuity, delivery reliability, cost stability, and operational efficiency when they systematically evaluate inflation-related risks and integrate those evaluations into managerial decisions. This result supports the logic of inflation-sensitive production planning models, which argue that time value of money, future price changes, machine deterioration, production rate variability, and maintenance timing must be incorporated into operational decisions (10). It also corresponds with studies examining fuzzy manufacturing and remanufacturing decisions under inflation, where inflation and time value of money are treated as essential components of production planning and sustainability-oriented decisions (27). Thus, the present study confirms that inflation risk assessment functions as a central mechanism connecting resource management capabilities to sustainable operational outcomes.

Cost-control capability emerged as the second strongest direct predictor of operational performance sustainability. This result is theoretically expected because inflation directly increases production costs, inventory costs, financing costs, and replacement costs. Firms with stronger cost-control systems can better protect margins, revise pricing policies, prevent waste, and allocate resources efficiently. However, the result also shows that cost-control capability alone is not sufficient; it must be linked with inflation risk assessment, production adaptability, procurement resilience, and technological decision support. This interpretation is consistent with sustainable inventory and green technology studies, which show that cost optimization must be balanced with preservation investment, carbon policy, deterioration control, and sustainability objectives (12, 13). Therefore, the findings suggest that cost control in inflationary manufacturing should not be reduced to expenditure reduction; rather, it should be considered a strategic capability for sustaining production performance under resource constraints.

Production planning adaptability had significant direct effects on both inflation risk assessment and operational performance sustainability. This means that firms capable of revising production schedules, adjusting capacity utilization, modifying batch sizes, and responding to input or demand fluctuations are more likely to perform sustainably in inflationary environments. This finding is aligned with research on reconfigurable manufacturing systems, where adaptability, modularity, responsiveness, and sustainable configuration changes are identified as core conditions for maintaining competitiveness in uncertain environments (15, 16). It is also supported by research on sustainable reconfigurable manufacturing design, which shows that production systems must balance economic performance, environmental goals, and operational responsiveness (21). Thus, the present study confirms that production planning adaptability is a practical expression of decision engineering in manufacturing firms facing inflationary instability.

The mediation results showed that inflation risk assessment significantly mediated the relationship between resource management capabilities and operational performance sustainability. The strongest indirect effect belonged to procurement and inventory resilience, followed by technological decision support and financial flexibility. This finding indicates that the positive effects of resource capabilities on performance are partly transmitted through the firm's ability to interpret and manage inflationary risk. In other words, resources do not automatically improve performance; they become performance-enhancing when they are connected to risk-sensitive decision processes. This result is consistent with systems engineering perspectives, which emphasize that effective decision-making requires the structured analysis of objectives, alternatives, uncertainty, risk, and system consequences (24). It is also consistent with integrated production and warehouse allocation research, where production planning and item-location allocation are treated as interconnected decision domains that jointly affect operational efficiency (25). Therefore, the mediation findings strengthen the argument that inflation risk assessment is the central decision mechanism of the proposed model.

The expert-based decision-engineering prioritization showed that strategic resource alignment, technological and data-driven decision support, financial flexibility, inflation risk assessment, and procurement and inventory resilience were the most influential cause factors in the final model. This result indicates that the most effective managerial interventions should begin with system-level alignment and information-based decision support rather than isolated operational corrections. Strategic resource alignment ranked first, suggesting that manufacturing firms need to align financial, human, technological, material, and production resources with strategic priorities before other capabilities can be fully effective. This finding is compatible with sustainability-oriented manufacturing studies showing that resource structures, green bill of materials, and multidisciplinary system design must be coordinated to maintain sustainable manufacturing performance (18, 19). It is also supported by longitudinal evidence on reconfigurable manufacturing systems, which demonstrates that successful implementation from design to full-scale production requires continuous alignment among technical design, organizational learning, and production requirements (23).

Overall, the findings indicate that the proposed model provides a coherent explanation of how manufacturing firms can sustain performance under inflationary economic conditions. The model shows that operational performance sustainability is not merely the outcome of cost control or production efficiency; it is produced through the integration of strategic alignment, financial flexibility, procurement resilience, technological decision support, inflation risk assessment, production adaptability, and market coordination. Prior literature has separately examined inflation-sensitive inventory systems, imperfect production, dynamic pricing, reconfigurable manufacturing, sustainability, and decision engineering (14, 20, 22, 28). The present study contributes by integrating these streams into an empirically validated model that explains both direct and mediated pathways to sustainable operational performance. The results therefore provide a practical framework for manufacturing managers who must make resource allocation and production decisions under persistent inflationary uncertainty.

This study had several limitations that should be considered when interpreting the findings. First, the quantitative data were collected from manufacturing firms located in Tehran, and although the sample included different industrial sectors, the findings may not fully represent the conditions of manufacturing firms in other regions or countries. Second, the study relied partly on self-reported questionnaire data, which may be affected by managerial perception, response bias, or organizational self-presentation. Third, although the model was statistically validated and supported by expert judgment, the cross-sectional design limited the ability to examine how the relationships among resource management capabilities, inflation risk assessment, and operational performance sustainability change over time. Fourth, the study focused on managerial and organizational dimensions and did not directly incorporate objective financial records, production-line data, or longitudinal cost indicators.

Future studies should test the proposed model in different industrial regions, economic contexts, and manufacturing sectors to examine its generalizability and contextual sensitivity. Researchers are encouraged to use longitudinal designs to investigate how inflationary shocks, policy changes, supply chain disruptions, and technological investments influence the model over time. Future research can also combine survey data with objective organizational indicators such as production costs, inventory turnover, delivery performance, machine downtime, working capital ratios, and profitability measures. Comparative studies between firms with high and low digital maturity would also be valuable for clarifying the role of data-driven decision support in inflation-sensitive resource management. In addition, future studies may extend the model by incorporating environmental sustainability indicators, human resource resilience, innovation capability, and external institutional factors.

Manufacturing managers should use the findings of this study to move from fragmented resource planning toward integrated decision architecture. Firms should strengthen strategic resource alignment by ensuring that financial, material, technological, human, and production resources are coordinated with organizational priorities. They should also invest in data-driven decision-support systems that provide timely information about costs, inventories, suppliers, demand patterns, and inflation-related risks. Procurement and inventory systems should be redesigned to improve resilience against price volatility, supplier instability, and material shortages. Financial managers should adopt flexible budgeting and working capital strategies that allow rapid adjustment to inflationary changes. Finally, operational managers should treat inflation risk assessment as a continuous managerial process embedded in production planning, cost control, supplier coordination, and performance monitoring.

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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 adheried 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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