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Weighted Dynamic Corridor Price Optimization

Optimizing Pricing Strategies in Capital Goods SMEs: A Weighted Dynamic Corridor Approach to Cost-Plus and Value-Based Pricing

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Abstract

Small and medium-sized enterprises (SMEs) in the capital goods sector face persistent challenges in developing pricing strategies that effectively balance cost recovery, competitive positioning, and value realisation amidst dynamic market conditions. This study introduces the Weighted Dynamic Corridor Price Optimisation (WDCP) framework, a novel hybrid model combining cost-plus and value-based pricing methodologies within a flexible pricing corridor.

The WDCP model establishes a minimum price grounded in production costs and strategic objectives, while the maximum price reflects customer-perceived value, psychological pricing thresholds, and external market dynamics. Empirical surveys among SME decision-makers and simulation analyses validate the framework, demonstrating its ability to enhance profitability, mitigate risks of over- or under-pricing, and provide superior pricing flexibility. Key features such as fixed cost degression, non-linear optimisation, and dynamic adjustments enable the model to adapt seamlessly to fluctuating market conditions and strategic priorities, including profit maximisation, market penetration, and customer retention.

By addressing the limitations of traditional cost-plus and value-based approaches, the WDCP framework bridges the gap between simplicity and market responsiveness. It integrates economic, psychological, and strategic factors into a practical, actionable pricing tool tailored to the unique needs of SMEs. This innovative approach fosters sustainable competitive advantages by equipping SMEs with the capacity to respond proactively to evolving customer demands and volatile industrial markets.

Keywords: pricing strategy, cost-plus pricing, value-based pricing, SMEs, dynamic pricing, WDCP framework

1. Introduction

In the modern industrial goods sector, small and medium-sized enterprises (SMEs) face increasingly complex challenges in pricing, driven by technological advancements, rising energy costs, geopolitical uncertainties, and growing customer expectations. These factors intensify competition and compel companies to continuously adjust their pricing strategies to secure long-term profitability and competitiveness. As (Simon & Fassnacht, 2016) note, a product's price not only directly impacts immediate profitability but also shapes its brand image and perceived value. Furthermore, (Frohmann, 2022) highlights the increasing relevance of digital tools in pricing, which enable companies to dynamically adjust prices based on market signals, further underscoring the importance of a flexible pricing strategy. Against this backdrop, selecting an appropriate pricing strategy becomes one of the most critical business decisions.

The common pricing approaches in the industrial goods sector predominantly include cost-plus pricing and value-based pricing. Cost-plus pricing, a method where a fixed markup is added to production costs, is commonly used in SMEs. It is transparent and straightforward, relying on clear cost factors and requiring minimal market knowledge (Stoppel, 2016). However, the cost-plus method is increasingly viewed critically. (Simon, 2013) argues that it often disregards customers' actual willingness to pay, making it less adaptable to market changes. (Diller, Beinert, Ivens & Müller, 2020) emphasize that while cost-plus pricing offers simplicity, it often fails to capture market dynamics and can lead to pricing decisions that overlook competitive positioning. They argue that companies relying solely on this approach may struggle to

differentiate themselves in increasingly volatile markets.

In contrast, value-based pricing focuses on the value perceived by customers and their willingness to pay. According to (Homburg & Totzek, 2011), this approach has gained increasing importance in recent years as it emphasizes specific customer benefits, thereby enabling competitive advantages in markets characterized by bespoke solutions and high differentiation. This view is supported by (Diller et al., 2020), who argue that value-based pricing aligns pricing strategies with customer value propositions, fostering stronger customer relationships and enabling higher profitability margins. However, implementing value-based pricing requires substantial investments in customer analysis and effective communication strategies. (Frohmann, 2022) adds that digital analytics and machine learning are becoming essential tools for SMEs to assess customer value accurately and implement dynamic pricing strategies. Despite these advancements, value-based pricing poses higher complexity and often greater implementation costs for SMEs.

Nevertheless, the ongoing relevance of the cost-plus strategy cannot be overlooked, as it remains a suitable option for standardized products and less differentiated markets, which are also present in the industrial goods sector. (Milz & Höfelmeier, 2023) argue that cost-plus pricing, when applied with enhanced cost tracking and operational efficiencies, can still be effective in volatile environments. (Diller et al., 2020) suggest that hybrid pricing models, which integrate elements of both cost-plus and value-based pricing, may provide a pragmatic solution for SMEs, allowing them to leverage simplicity in stable market segments while tapping into customer value in more dynamic contexts. This raises the question of how SMEs can strike a balance between both approaches and to what extent hybrid models can combine the advantages of both.

The aim of this paper is thus to systematically analyse the advantages and disadvantages of both pricing strategies and to evaluate their impact on the economic performance of industrial goods SMEs. Based on this analysis, a framework will be developed to serve as a decision-making tool for SMEs, enabling optimal pricing strategies that account for market conditions, product characteristics, and specific customer requirements.

2. Methodology

This study employs a combined methodological strategy that integrates theoretical and empirical elements to provide a robust foundation for the development of the Weighted Dynamic Corridor Price Optimization (WDCP) model. The aim is to address the specific requirements of small and medium-sized enterprises (SMEs) in the capital goods sector.

The initial phase involved a systematic review of existing literature to analyse theoretical approaches and models related to cost-plus and value-based pricing. The reviewed sources include academic publications in pricing management, marketing, and strategic business management. Particular attention was paid to the challenges SMEs face, such as limited resources for market research and the need to develop differentiated market strategies.

The WDCP model was developed by combining theoretical concepts with mathematical optimization. The model integrates:

1) Cost-Oriented Pricing: Calculation of a minimum price, factoring in fixed and variable costs as well as strategic adjustments.

2) Value-Oriented Pricing: Determination of a maximum price based on customer perception, market conditions, and technological factors.

3) Dynamic Pricing: Definition of a flexible pricing corridor between these boundaries, optimized through weighted cost and value components.

To validate the WDCP model and understand the relative importance of key pricing factors, an empirical survey was conducted among decision-makers in SMEs with extensive experience in pricing management for capital goods. The survey findings emphasize competition intensity and perceived quality as critical factors influencing pricing decisions, alongside other variables such as brand image and purchasing power. These insights were used to refine the WDCP model, ensuring its alignment with practical market dynamics and customer expectations.

Participants were asked to assess the relevance of twelve predefined factors, including perceived quality, competition intensity, and differentiation features. The responses provided a structured understanding of the key elements influencing pricing strategies. This empirical data was analysed to identify patterns and prioritize factors that impact pricing decisions, helping to define the dynamic pricing corridor.

The findings were cross-referenced with theoretical insights from the literature review to ground the model in both scientific and practical contexts. This iterative approach enabled the WDCP model to be fine-tuned for flexibility and adaptability, addressing varying market conditions and customer requirements.

Finally, the refined WDCP model was validated through simulations, analysing diverse scenarios to test its robustness and practical applicability. These simulations highlighted the model's capability to enhance profitability, adapt to

fluctuating market dynamics, and support SMEs in crafting competitive and responsive pricing strategies.

2.1 Cost-Plus Pricing

Cost-plus pricing is a traditional method, particularly prevalent among small and medium-sized enterprises (SMEs). Its success and popularity are attributed to its simplicity and transparency: companies calculate their production costs and add a fixed markup to ensure a profit margin (Wiltinger, 1998). This method provides SMEs, which often operate with limited resources and market access, with a quick, clear, and straightforward way to set prices. (Simon, 2019) emphasizes that the calculation is conducted internally, requiring no extensive market analysis, making it particularly suitable for businesses with limited resources and expertise in pricing research.

The benefits of cost-plus pricing lie primarily in risk mitigation and margin stability. Since price calculations are directly based on production costs, industrial goods SMEs find it easier to plan and secure their contribution margins. In volatile markets or during significant fluctuations in production costs, this method ensures that prices at least cover costs, reducing the risk of financial losses. This provides a level of stability and predictability that is crucial for many SMEs.

However, the cost-plus method also has significant drawbacks. Firstly, it does not account for the value customers assign to a product. Since prices are based solely on production costs, they may overlook customer perceptions, leading to the risk of over- or under-pricing (Schuppar, 2021). (Abidin, Jamaluddin, Tanggamani, Nadia & Sapari, 2023) emphasize that this approach may limit a firm's ability to create a competitive advantage, as it does not leverage market insights or customer-driven strategies. This lack of market flexibility can be disadvantageous, especially when competitors are more responsive to customer needs and market dynamics. Additionally, (Monroe, 2019) argues that this method can hinder the development of innovative products because it relies solely on costs and therefore lacks incentives for value enhancement or differentiation.

Key advantages of cost-plus pricing include:

1) Simplicity and transparency: Pricing is based on fixed production costs plus a markup, making the process predictable and less resource intensive.

2) Risk mitigation: By ensuring that production costs are covered, this method lowers the risk of negative contribution margins, particularly beneficial in price-sensitive or volatile markets.

2.2 Value-Based Pricing

In contrast to cost-plus pricing, value-based pricing centres on the perceived value from the customer’s perspective. As (Nagle & Müller, 2018) explain, this approach aims to set prices that reflect customer value, necessitating detailed analysis of customer segments and their willingness to pay. Companies adopting value-based pricing focus primarily on customer benefits, seeking to achieve greater customer loyalty and revenue growth through tailored offerings and differentiated pricing. According to (Homburg & Totzek, 2011), this method is particularly advantageous in highly differentiated and competitive industrial goods markets, as it enables optimal utilization of customers' willingness to pay.

A key advantage of value-based pricing lies in its flexibility and adaptability to market needs (Baker, 2010). By concentrating on customer benefits, companies can adjust their prices to align with the specific preferences and willingness to pay of their target groups. (Simon, 2013) highlights that this allows businesses to establish a differentiated market position, often leading to stronger relationships with customer groups willing to pay a premium for added value. (Abidin et al., 2023) argue that value-based pricing not only strengthens customer relationships but also serves as a critical driver for achieving a sustainable competitive advantage, as it aligns pricing decisions with the unique value propositions of the firm.

However, implementing value-based pricing presents challenges. Analysing customer preferences and willingness to pay requires extensive market research, demanding additional resources and specialized expertise (Simon & Fassnacht, 2016). For industrial goods SMEs with limited resources, this can pose a significant obstacle. Furthermore, customer-focused pricing is often time-consuming and requires regular updates to adapt to changing market conditions and customer preferences.

Key advantages of value-based pricing include:

1) Adaptability to market needs: This customer-focused pricing approach allows SMEs to flexibly adjust products and prices to match the willingness to pay and needs of their target groups, thereby achieving a differentiated market position.

2) Revenue optimization: By aligning prices more closely with customer needs, businesses can achieve higher margins.

2.3 Theoretical Framework

The proposed framework is based on key internal and external factors influencing pricing decisions in SMEs within the industrial goods sector. It considers the strengths and weaknesses of both cost-plus and value-based pricing methods,

proposing a hybrid decision-making model. This model aims to optimise pricing strategies by adapting them to internal structures and external market conditions. Through this flexible and differentiated approach, the framework offers SMEs a practical decision-making tool to thrive in increasingly competitive industrial goods markets, such as the automotive supply industry.

2.3.1 Internal Factors

1) Production Costs and Margins: A company's internal cost structure plays a crucial role in pricing, as emphasized by (Siems, 2009). SMEs with stable and transparent cost structures often prefer cost-plus pricing due to its straightforward approach and secure margin protection. This method is prevalent among SMEs with standardized products and a focus on cost efficiency, as it supports planning and profitability. Conversely, SMEs offering differentiated, high-value products can achieve higher margins through value-based pricing, as they target customers' willingness to pay, according to (Backhaus & Voeth, 2014).

2) Resources for Market Analysis: Implementing a value-based pricing strategy requires sufficient resources for market and customer analysis to precisely identify customer preferences and needs, as highlighted by (Simon & Fassnacht, 2016). However, this is a challenge for many SMEs, given the cost and time-intensive nature of comprehensive market and competitive analysis, noted by (Goeke, 2008). Building such resources is a long-term investment that enables SMEs to adopt value-based pricing adjustments, thereby achieving higher returns.

2.3.2 External Factors

1) Market Volatility and Competition: The intensity of competition and market dynamics significantly influence a company's pricing strategy, as noted by (Homburg, 2017). In highly competitive and volatile markets, value-based pricing offers SMEs a way to stand out, particularly when they offer differentiated products with significant customer benefits. Such markets require flexibility, as frequent price adjustments are necessary, and a purely cost-plus strategy often falls short in addressing short-term market changes and rising customer demands, as observed by (Herr, Bedrucker, & Frahm, 2013).

2) Customer Requirements and Price Sensitivity: Customer orientation is increasingly a key factor in pricing and sustainable customer retention, as noted by (Simon, 2013). Customer segments that place high value on product benefits expect prices that align with their specific expectations. (Ali, 2024) highlights that pricing strategies, such as discounts and bundling, significantly influence consumer perception and purchase behaviour, particularly in industrial goods markets. The ability to adapt to customer price sensitivity and value needs enables SMEs to flexibly adjust prices and build long-term customer relationships, as discussed by (Schuh, Leiting, & Schrank, 2022). Customer retention and orientation thus become central elements that businesses can leverage for differentiation and long-term competitiveness.

2.3.3 Hybrid Pricing Decision Model

A practical pricing decision model combines cost-plus and value-based pricing into a hybrid approach. This model seeks to leverage the strengths of both methods, enabling balanced and market-oriented pricing. Key pricing factors, such as production costs, customer value perceptions, and market conditions, are systematically evaluated and integrated into a dynamic pricing formula. This formula determines the final product or service price, providing decision-makers with a flexible and actionable tool for practical implementation.

The core concept of the model is achieving a balance between internal cost orientation and external value orientation, realized through systematic weighting and mathematical aggregation. This allows SMEs in the industrial goods sector to establish pricing strategies that are both economically viable and market relevant.

1) Cost-Oriented Pricing: This approach ensures that a company's fundamental costs are covered, factoring in fixed costs, variable costs, and an appropriate profit margin. It offers transparency and reduces the risks associated with insufficient cost coverage. This perspective is particularly suitable for ensuring economic stability and preventing short-term losses.

2) Value-Oriented Pricing: This approach aligns with customer needs and preferences, focusing on the perceived value of a product. It considers factors such as quality perception, specific customer requirements, and the company's competitive position. The goal is to set prices that are not only cost-covering but also competitive and capable of maximizing profitability.

By integrating these two perspectives, the hybrid model allows SMEs to respond effectively to diverse market conditions and customer demands, ensuring long-term sustainability and competitiveness.

2.4 Weighted Dynamic Corridor Price Optimization

Pricing is a cornerstone of strategic decision-making, especially in small and medium-sized enterprises (SMEs) operating in industrial markets. These firms face unique challenges, such as balancing cost recovery, competitive pressures, and the need to adapt to evolving customer expectations. Traditional pricing approaches such as cost-plus pricing focus on

covering production costs while adding a profit margin. While simple and practical, this approach often disregards external factors such as market dynamics, customer perceptions of value, and negotiation realities.

In contrast, value-based pricing seeks to capture the price customers are willing to pay based on perceived benefits. While highly effective in maximizing profitability, it risks neglecting cost constraints and operational sustainability, particularly for SMEs with limited resources.

To address these shortcomings, this research introduces the Weighted Dynamic Corridor Price Optimization (WDCP) model. This novel framework integrates the strengths of cost-plus pricing and value-based pricing, enhanced by a dynamic price corridor. The model accommodates psychological, technological, and market-driven factors, ensuring its adaptability in competitive industrial markets. The WDCP model enables firms to:

1) Define a defensible *minimum price* based on cost structures and strategic adjustments.

2) Establish a *maximum price* informed by customer-perceived value and external market conditions.

3) Optimize pricing within a *dynamic price corridor*, weighted by cost and value considerations.

4) Adapt prices dynamically with negotiation margins and discounts.

The following sections detail the mathematical formulation of the WDCP model, its components, and its applicability.

2.4.1 Mathematical Framework of the WDCP Model

1) Determining the Minimum Price (P_{min})

The minimum price ensures cost coverage while incorporating a strategic adjustment component for specific business goals. It is calculated as:

$$P_{\text{min}} = K_{\text{fix, per unit}} + K_{\text{var, per unit}} + S_{\text{strat}} \tag{1}$$

Fixed Costs Per Unit **(**$K_{\text{fix, per unit}}$**)**: Fixed costs are recurring expenses independent of production volume, such as rent, depreciation, and salaries. These costs are allocated to individual units based on planned production volume (M):

$$K_{\text{fix, per unit}} = \frac{\sum_{i=1}^{n} F_i}{M} \tag{2}$$

F_i: Fixed cost of the i-th category (e.g., rent, equipment depreciation), n: Number of fixed cost categories and M: Planned production or sales volume. *Variable Costs Per Unit* **(**$K_{\text{var, per unit}}$**)**: Variable costs depend on production volume and include expenses like raw materials and utilities. These costs are calculated as:

$$K_{\text{var, per unit}} = \sum_{j=1}^{m} (V_j \cdot Q_j) \tag{3}$$

V_j: Cost per unit of the j-th variable factor (e.g., material cost per item), Q_j: Quantity of the j-th factor consumed per unit and m: Number of variable cost categories. *Strategic Adjustment* **(**S_{strat}**)**: Strategic pricing adjustments reflect objectives such as entering a new market or nurturing key customer relationships. These adjustments are modelled as:

$$S_{\text{strat}} = P_{\text{target}} \cdot r_{\text{strat}} \tag{4}$$

P_{target}: Target price before adjustment and r_{strat}: Strategic adjustment factor ($r_{\text{strat}} > 0$ for markups, $r_{\text{strat}} < 0$ for discounts).

2) Determining the Maximum Price (P_{max})

The maximum price represents the upper limit of what customers are prepared to pay, shaped by their perception of value and external influences. It is determined using the following calculation:

$$P_{\text{max}} = W_{\text{basis}} \cdot M_{\text{market}} \cdot T_{\text{technology}} \tag{5}$$

Customer Value **(**W_{basis}**)**: The base value of a product is derived from the utility of its features and benefits as perceived by customers. It is calculated as:

$$W_{\text{basis}} = \sum_{k=1}^{o} f\,(U_k, Z_k) \tag{6}$$

U_k: Perceived utility of the k-th feature or benefit (e.g., time savings, quality), Z_k: Weight assigned to the k-th feature, reflecting its importance and o: Total number of product features. *Market Factors* **(**M_{market}**)**: Market conditions, such as competition and demand elasticity, influence price ceilings. These factors are expressed as:

$$M_{\text{market}} = 1 + (m_{\text{premium}} - m_{\text{discount}}) \tag{7}$$

m_{premium}: Market premium for uniqueness or differentiation and m_{discount}: Discount reflecting competitive pressures.

Technological Adjustment **(**$T_{\text{technology}}$**)**: Technological innovation or obsolescence affects perceived value. This is modelled as:

$$T_{\text{technology}} = 1 + t_{\text{innovation}} \tag{8}$$

$t_{\text{innovation}}$: Percentage adjustment for technological factors (positive for innovation, negative for obsolescence).

3) Establishing the Dynamic Price Corridor

The price corridor P_{corridor} is defined as the range bounded by the minimum and maximum prices:

$$P_{\text{corridor}} = [P_{\text{min}}, P_{\text{max}}] \tag{9}$$

Within this range, the *optimal price* (P_{opt}) is determined by weighting cost-based and value-based components:

$$P_{\text{opt}} = w_{\text{cost}} \cdot P_{\text{min}} + w_{\text{value}} \cdot P_{\text{max}} \tag{10}$$

w_{cost}: Weight assigned to cost considerations, w_{value}: Weight assigned to value considerations. $w_{\text{cost}} + w_{\text{value}} = 1$.

4) Final Price with Discounts

The final price incorporates negotiation margins or customer-specific discounts:

$$P_{\text{final}} = P_{\text{opt}} \cdot (1 - R) \tag{11}$$

R: Discount rate ($0 \leq R \leq 1$).

2.4.2 Integrating Key Account Flexibility into the WDCP Model

Building on the Weighted Dynamic Corridor Price Optimization (WDCP) model, this enhancement introduces a strategic extension designed to accommodate key account relationships. While the original model provides a robust framework for balancing cost recovery, value-based pricing, and market adaptability, it assumes a strict adherence to the minimum price to ensure profitability.

In industrial markets, however, key accounts often represent a significant portion of revenue and strategic value, making it beneficial to accept orders with negative contribution margins under certain conditions. This proposed enhancement integrates mechanisms to quantify and justify such decisions. By incorporating a key account component into the WDCP model, businesses can navigate the trade-offs between short-term losses and long-term strategic gains, ensuring the model remains relevant and actionable in competitive, relationship-driven contexts.

1) Key Account Component

A special component is introduced to account for strategic relationships with key accounts. This component lowers the minimum price (P_{min}) to support strategic objectives.

Adjustment of S_{strat}:

Extend S_{strat} by adding a key account factor r_{key}, which justifies additional discounts or negative contribution margins:

$$S_{\text{strat}} = P_{\text{target}} \cdot (r_{\text{strat}} + r_{\text{key}}) \tag{12}$$

r_{key}: Additional discount factor for key accounts (e.g., $r_{\text{key}} < 0$ for reductions).

The negative factor r_{key} is activated only for predefined key accounts or specific business scenarios.

2) Long-term Profitability Analysis

Accepting orders with negative contribution margins is often justified only if they promise long-term benefits. To address this, the model can introduce a strategic benefit value V_{key}, which quantifies the potential added value from customer retention.

Calculation of V_{key}:

$$V_{\text{key}} = \sum_{t=1}^{T} (R_{\text{future}} \cdot (1 - d)^t) \tag{13}$$

R_{future}: Expected future revenues from the customer, T: Evaluation period in years and d: Discount rate (e.g., cost of capital).

This benefit value can influence pricing by justifying the acceptance of negative contribution margins.

3) Dynamic Adjustment of Weighting Factors

The weighting of cost and value considerations can be flexibly adjusted for key accounts to prioritize value-based pricing over cost considerations. For example:

For key accounts, $w_{\text{cost}} < w_{\text{value}}$ could be defined, allowing higher discounts.

Alternatively, P_{opt} could be directly reduced by applying a key account discount.

4) Incorporating Strategic Goals into the Price Corridor

The price corridor ($P_{\text{corridor}} = [P_{\text{min}}, P_{\text{max}}]$) can be expanded for key accounts by temporarily lowering the minimum price:

$$P_{\text{corridor, key}} = [P_{\text{min, key}}, P_{\text{max}}] \tag{14}$$

$P_{\text{min, key}} = P_{\text{min}} \cdot (1 - r_{\text{key}})$: New minimum price, incorporating a key account discount.

5) Integration into Decision Logic

An additional decision parameter D_{key} assesses whether accepting an order with a negative contribution margin is justified:

$$D_{\text{key}} = \begin{cases} \text{Yes}, & \text{if } V_{\text{key}} > \mid DB_{\text{negative}} \mid \\ \text{No}, & \text{if } V_{\text{key}} \leq \mid DB_{\text{negative}} \mid \end{cases} \tag{15}$$

DB_{negative}: Absolute value of the negative contribution margin and V_{key}: Long-term strategic benefit of the key account.

2.4.3 Conclusion of the Weighted Dynamic Corridor Price Optimization model

The Weighted Dynamic Corridor Price Optimization (WDCP) model is a versatile pricing framework that combines cost efficiency with market adaptability. By integrating cost-based pricing, value-driven considerations, and dynamic adjustments, it empowers SMEs to balance profitability with competitiveness. Furthermore, the inclusion of negotiation margins enhances its flexibility, ensuring its relevance in diverse industrial contexts.

Building on this foundation, the model is further enhanced to address scenarios where accepting orders below the price floor (P_{min}) may be strategically advantageous. By introducing a key account component, the WDCP model now accommodates the long-term value of key relationships, enabling SMEs to justify temporary negative contribution margins. This extension ensures that the model remains robust and applicable in contexts where strategic partnerships and future revenue potential outweigh immediate profitability concerns.

This comprehensive model lays the foundation for future research into adaptive pricing mechanisms and their practical applications in SME settings, while incorporating a nuanced approach to key account management.

2.5 Integration of an Empirical Survey into the WDCP Model

2.5.1 Objective of the Survey

To complement the theoretical foundations of the Weighted Dynamic Corridor Price Optimization (WDCP) model, an empirical survey was conducted with managers from small and medium-sized industrial goods companies.

The survey findings strongly emphasize the role of competition intensity and perceived quality as critical factors influencing pricing decisions. These insights refine the WDCP model, aligning theoretical assumptions with practical applications.

The aim of the survey was to gain practical insights into perceptions of price fairness and purchasing decisions. Specifically, the survey sought to analyse which influencing factors were perceived as particularly relevant for assessing price fairness and willingness to purchase, and how these insights could be integrated into the WDCP model.

The survey was based on twelve predefined variables that represent key influencing factors from the customer's perspective, including perceived quality, brand image, differentiation features, and competition intensity. The results aim to refine the weighting factors in the WDCP model and align the calculation of the dynamic pricing corridor more closely with real market conditions.

2.5.2 Survey Methodology

The survey was conducted using an intersubjective approach, based on the Analytic Hierarchy Process (AHP) method. This method enables participants to rate the importance of individual variables on a scale of 1 to 10, where 1 represents "unimportant" and 10 signifies "very important."

The twelve variables were presented to the survey participants, who were decision-makers and managers. They were asked to evaluate the relevance of these criteria for the target audience when it comes to perceptions of price fairness and purchasing decisions.

The variables and their definitions are summarized in (Appendix A). For example, the variable "perceived quality" reflects the contribution of product quality to the purchasing decision, while "brand image" represents the trust and prestige associated with a brand. These factors bridge the gap between customer perspectives and the pricing theory underpinning the WDCP model.

2.5.3 Survey Results and Implications

The survey analysis (Appendix B) revealed that Competition Intensity (7.79), Purchasing Power (7.50), and Perceived Quality (7.36) play a central role in the evaluation of market and customer factors. These findings were corroborated by the expert evaluation, which identified the same aspects as the three most important factors.

The low variance in factors such as Competition Intensity suggests strong consistency in responses, whereas greater variability (e.g., in Provider Trust or Price Promotions) may indicate context-dependent differences. Interestingly, both the respondents and the experts rated factors such as Personalization (5.64) and Price Promotions (6.14) as comparatively less important. These results suggest that long-term competitive factors carry more weight than short-term marketing strategies.

These insights have direct implications for the application of the WDCP model. They underscore the central role of (W_{basis}) (customer value) in the calculation of (P_{max}). Factors such as perceived quality and brand image highlight the importance customers place on the perceived value of a product. At the same time, variables such as competition intensity and availability demonstrate that market conditions require dynamic adjustments to the pricing corridor, emphasizing the necessity of a flexible pricing model such as the WDCP.

2.5.4 Linking the Results to the WDCP Model

The survey results can be integrated into the WDCP model as follows:

1) Cost Component (P_{min}): Variables such as "income and purchasing power" and "availability" influence how the lower boundary of the pricing corridor should be structured. These insights can help make (P_{min}) more responsive to the financial constraints of the target audience.

2) Value Component (P_{max}): Perceived quality, brand image, and differentiation features underscore the significance of perceived customer value (W_{basis}) in the calculation of (P_{max}). Specifically, it was found that customers are willing to pay higher prices for products that convey a high level of quality and brand trust.

3) Dynamic Adjustments: Competition intensity and price promotions indicate that price adjustments within the dynamic pricing corridor are necessary to respond to changing market conditions. These findings support the WDCP model's assumption that a flexible weighting system (W_{cost} and W_{value}) is essential.

2.5.5 Discussion and Conclusion

The results of the empirical survey validate the core assumptions of the WDCP model and extend them with practical insights. In particular, the findings highlight that the perception of quality and brand image are key drivers of price willingness, reinforcing the importance of the (P_{max}) component. At the same time, it becomes evident that dynamic market conditions, represented by variables such as competition intensity and availability, require a flexible adjustment of the pricing corridor.

The survey findings strongly emphasize the role of competition intensity and perceived quality as critical factors influencing pricing decisions. These insights refine the WDCP model, aligning theoretical assumptions with practical applications.

This empirical study not only provides valuable insights for further developing the WDCP model but also offers actionable recommendations for small and medium-sized industrial goods companies. It demonstrates that differentiated pricing strategies that consider both the perceptions of the target audience and dynamic market conditions can create competitive advantages.

2.6 Mathematical Formulation of the WDCP Model

2.6.1 Introduction

The mathematical formulation underpins the WDCP model, ensuring scientific rigour, transparency, and reproducibility of results. By explicitly presenting the objective function, constraints, and derivations, this section provides the foundation for comprehending and adapting the model to various contexts. This formulation is crucial for addressing the complex optimisation challenges inherent in the WDCP framework.

2.6.2 Objective Function and Constraints

The WDCP model aims to maximise profitability $\Pi(P)$, which is expressed as a function of price P:

$$\Pi(P) = Q(P) \cdot (P - C) + R(Q) \tag{16}$$

$Q(P)$: Demand as a function of price P, C: Unit cost, $R(Q)$: Volume-based rebates.

The optimisation is subject to the following constraints:
Dynamic Price Corridor:
The price P must lie within a defined corridor:

$$P_{\min}(Q) \leq P \leq P_{\max}(Q) \tag{17}$$

$P_{\min}(Q)$ and $P_{\max}(Q)$ represent the lower and upper bounds, respectively.
Minimum Price:

The minimum price $P_{\min}(Q)$ ensures cost coverage and incorporates strategic adjustments:

$$P_{\min}(Q) = \frac{\text{Fixed Costs}}{Q} + \sum_{j=1}^{m} VC_j \cdot u_j + S \tag{18}$$

VC_j: Variable cost of the j-th factor, u_j: Usage of the j-th factor per unit and S: Strategic slack component.
Maximum Price:
The maximum price $P_{\max}(Q)$ reflects market-driven and psychological considerations:

$$P_{\max}(Q) = \left(a - \alpha Q^{1/n}\right) \cdot (1 + T \cdot V) \tag{19}$$

a: Maximum potential demand, α: Demand sensitivity factor, n: Non-linear elasticity exponent,
T: Technological adjustment factor and V: Market differentiation factor.

2.6.3 Lagrange Function

The optimisation integrates the objective function and constraints using the Lagrange multiplier method. The Lagrange function is defined as:

$$\mathcal{L}(P, Q, \lambda_1, \lambda_2) = Q(P) \cdot (P - C) + R(Q) + \lambda_1 \cdot (P_{\min}(Q) - P) + \lambda_2 \cdot \left(P - P_{\max}(Q)\right) \tag{20}$$

λ_1, λ_2: Lagrange multipliers enforcing the price bounds.

2.6.4 First-Order Conditions and Complementary Slackness

The first-order conditions for optimisation are derived as follows:
1) Partial Derivative with Respect to P:

$$\frac{\partial \mathcal{L}}{\partial P} = Q'(P) \cdot (P - C) + Q(P) - \lambda_1 + \lambda_2 = 0 \tag{21}$$

2) Partial Derivative with Respect to Q:

$$\frac{\partial \mathcal{L}}{\partial Q} = (P - C) \cdot Q'(P) + R'(Q) + \lambda_1 \cdot \frac{\partial P_{\min}(Q)}{\partial Q} - \lambda_2 \cdot \frac{\partial P_{\max}(Q)}{\partial Q} = 0 \tag{22}$$

3) Enforcing Constraints:

$$\frac{\partial \mathcal{L}}{\partial \lambda_1} = P_{\min}(Q) - P = 0, \quad \frac{\partial \mathcal{L}}{\partial \lambda_2} = P - P_{\max}(Q) = 0 \tag{23}$$

The complementary slackness conditions ensure that the multipliers activate only when the respective constraints are binding:

$$\lambda_1 \cdot (P_{\min}(Q) - P) = 0, \quad \lambda_2 \cdot \left(P - P_{\max}(Q)\right) = 0, \quad \lambda_1, \lambda_2 \geq 0 \tag{24}$$

2.6.5 Relation to the WDCP Framework

The mathematical formulation directly supports the operational logic of the WDCP model, enabling dynamic and adaptive pricing strategies:

1) Dynamic Price Determination:
The final price P is computed as a weighted combination of cost-based P_{costs} and value-based P_{value} components:

$$P = G_C \cdot P_{\text{costs}} + G_W \cdot P_{\text{value}} + K(Q) \tag{25}$$

$G_C + G_W = 1$: Weights for cost and value components, $K(Q)$: Flexibility factor for key accounts.
1) Value-Based Pricing Component:
The value-based component P_{value} integrates customer preferences and market adjustments:

$$P_{\text{value}} = \sum_{i=1}^{n} w_i \cdot x_i + M \tag{26}$$

w_i: Weight of the i-th factor, x_i: Expert evaluation of the i-th factor and M: Market-driven adjustment.
2) Volume-Based Rebates:
Rebates $R(Q)$ are applied based on volume thresholds:

$$R(Q) = \begin{cases} r_1 & \text{if } Q < Q_1, \\ r_2 & \text{if } Q_1 \leq Q < Q_2, \\ r_3 & \text{if } Q \geq Q_2. \end{cases} \tag{27}$$

2.6.6 Conclusion

The mathematical framework elucidates the core mechanisms of the WDCP model, ensuring robustness and flexibility. It provides a structured approach for balancing cost efficiency and value realisation while adapting to dynamic market conditions. This formulation enables businesses to optimise pricing strategies, aligning them with strategic objectives and customer needs.

3. Results

The implementation of the Weighted Dynamic Corridor Price Optimisation (WDCP) framework demonstrated significant advancements in the pricing strategies employed by small and medium-sized enterprises (SMEs) in the capital goods sector. This framework, which integrates cost-plus and value-based pricing within a dynamic pricing corridor, has been validated through simulations and empirical evaluations, revealing its capacity to address both economic and psychological factors in pricing decisions.

Simulations conducted to assess the WDCP model's performance showed that the framework consistently enhanced profitability by optimising price points within a flexible range. The lower boundary of the corridor, based on production costs and strategic slack, ensured cost coverage and financial stability, while the upper boundary, determined by customer willingness to pay, psychological thresholds, and market dynamics, allowed SMEs to capture additional value. These results indicate a reduction in the risks associated with under-pricing in highly competitive markets and overpricing in price-sensitive contexts.

Empirical validation, involving expert evaluations from industry professionals, provided further insights into the framework's practical applicability. Key factors such as competition intensity and perceived quality emerged as critical influences on pricing decisions. For instance, high competition intensity was frequently cited as necessitating narrower pricing corridors, while perceived quality enabled broader corridors that captured premium pricing opportunities. The Analytic Hierarchy Process (AHP) is mentioned as a potential weighting mechanism for systematically incorporating factors such as brand positioning and customer loyalty. However, it was not applied in this study. Instead, an empirical survey was conducted to evaluate key pricing factors, providing practical insights into their relevance and impact on pricing decisions.

The inclusion of advanced mechanisms such as non-linear optimisation and fixed cost degression contributed to the model's adaptability. Non-linear optimisation facilitated adjustments to rapidly changing market conditions, while fixed cost degression supported scalability by redistributing costs over larger production volumes. This adaptability allowed SMEs to align their pricing strategies dynamically with fluctuations in market demand, capacity constraints, and organisational goals, such as enhancing market penetration or prioritising profitability.

Overall, the results affirm the WDCP framework's robustness and flexibility, providing a scientifically grounded tool that equips SMEs to navigate the complexities of industrial markets. By balancing cost-based and value-driven considerations within a dynamic and empirically validated structure, the framework enables SMEs to achieve sustainable competitive advantages through optimised pricing strategies.

4. Discussion of Findings

The results presented in this research offer valuable insights into the efficacy of weighted dynamic corridor price optimisation within the context of industrial goods markets. The findings align with prior studies that emphasise the importance of tailoring pricing strategies to dynamic market conditions, reinforcing the notion that static methods fail to capture the complexities of contemporary markets. However, this study expands the scope by introducing a weighting mechanism, offering a nuanced understanding of how varying factors, such as demand elasticity and competitor activity, influence optimal pricing.

While the model demonstrated robust performance in most scenarios, certain limitations were observed. Notably, its sensitivity to abrupt market shocks, such as sudden regulatory changes or economic disruptions, raises questions about its adaptability under extreme conditions. This observation aligns with earlier critiques of algorithmic pricing, highlighting the trade-off between model complexity and operational resilience. Future iterations of the model could address this by integrating real-time market intelligence or incorporating stochastic elements to mitigate uncertainty.

Furthermore, the complexity of the model may present significant challenges for small and medium-sized enterprises (SMEs). These organisations often operate with limited resources, making the implementation of a sophisticated pricing framework both time- and cost-prohibitive. The necessity for advanced data analytics capabilities and continuous

adjustments to align with market dynamics might exceed the capacities typically available to SMEs. SMEs may also lack access to the specialised expertise required to effectively implement and sustain such models. As a result, simplifications in model design or the provision of modular, pre-configured solutions could significantly enhance accessibility. For instance, offering industry-specific templates or automated features could streamline adoption while reducing associated costs and resource demands.

In addition, the behavioural responses of SMEs themselves, including their risk aversion and decision-making frameworks, might influence their willingness to adopt complex models. Addressing these behavioural aspects through education, user-friendly interfaces, and integration support could foster greater acceptance and effective implementation. For example, tailored training sessions, visual dashboards, and intuitive tools might empower SMEs to engage more confidently with the pricing model.

Additionally, sector-specific insights reveal potential challenges in adoption. For industries characterised by low-margin, high-volume transactions, the initial implementation costs of dynamic corridor pricing might deter adoption despite its long-term benefits. This underscores the importance of considering organisational readiness and market structure when applying such strategies. Moreover, the behavioural responses of consumers and competitors emerged as a critical factor influencing the model's outcomes. While this study primarily focused on quantitative metrics, future research could explore qualitative aspects, such as how consumer perceptions of fairness impact willingness to pay when prices fluctuate within defined corridors. Exploring cultural and regional differences in pricing acceptance could further refine the model's applicability across diverse markets.

Overall, while the weighted dynamic corridor price optimisation model represents a promising advancement, addressing its inherent complexity and tailoring it to meet the needs of resource-constrained organisations remains pivotal. Future research should focus on refining the model's scalability, incorporating adaptive features, and exploring real-world implementation case studies to ensure its viability across a broad spectrum of industrial and commercial settings.

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Authors contributions

Konrad Stromeyer and Dr. Walter Kurz were responsible for study design and revising. Dr. Walter Kurz was responsible for data collection. Konrad Stromeyer drafted the manuscript and Dr. Walter Kurz revised it. All authors read and approved the final manuscript. In this paragraph, also explain any special agreements concerning authorship, such as if authors contributed equally to the study.

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Appendix A: Expert-Supported, Intersubjective AHP Assessment

No.	Variable	Value Contribution/Customer Perspective	How important is this criterion for target groups (customers) in evaluating price fairness and purchase decisions?
1	Perceived Quality	How important is the quality perceived by the target group when making a purchase?	1-10 Rating
2	Brand Image	How strongly does the brand influence the target group's trust and prestige in the purchasing decision?	1-10 Rating
3	Differentiation Features	How relevant are the unique features of the product for the target group?	1-10 Rating
4	Provider Trust	How important is the trust in the provider for the target group when evaluating price fairness?	1-10 Rating
5	Customer Service	How highly does the target group value the quality and availability of consultation and support?	1-10 Rating
6	Personalisation	How important is the adaptation of services to the individual needs of the target group?	1-10 Rating
7	Income and Purchasing Power	How strongly do financial capacities influence the target group's purchasing decisions and price fairness perception?	1-10 Rating
8	Values and Lifestyle	How significant are cultural and personal preferences of the target group for their purchasing behaviour?	1-10 Rating
9	Risk Aversion	How important is safety and quality to the target group?	1-10 Rating
10	Competition Intensity	How strongly does the availability of alternatives influence the target group's decisions?	1-10 Rating
11	Availability	How important is the availability or exclusivity of the offer for the target group?	1-10 Rating
12	Price Promotions	How important are discount and special offer promotions for the target group?	1-10 Rating

Appendix B: Survey Results and Expert Rankings and Values from the Survey

#	Factor	Mean	StDev	Min	Max	Median	Range	IQR
F1	Perceived Quality	7.36	2.21	4.00	10.00	8.00	6.00	3.50
F2	Brand Image	6.93	2.09	3.00	10.00	7.00	7.00	1.75
F3	Differentiation Features	7.29	1.27	5.00	9.00	7.00	4.00	1.75
F4	Provider Trust	7.00	2.54	3.00	10.00	8.00	7.00	4.00
F5	Customer Service	7.00	1.57	4.00	9.00	7.00	5.00	2.50
F6	Personalisation	5.64	2.06	2.00	8.00	5.50	6.00	3.75
F7	Purchasing Power	7.50	2.21	5.00	10.00	7.50	5.00	4.50
F8	Values and Lifestyle	7.21	1.76	4.00	10.00	7.50	6.00	2.75
F9	Risk Aversion	6.93	2.43	3.00	10.00	8.00	7.00	4.00
F10	Competition Intensity	7.79	1.48	6.00	10.00	7.50	4.00	1.75
F11	Availability	6.79	1.85	4.00	9.00	7.00	5.00	3.50
F12	Price Promotions	6.14	2.51	2.00	10.00	6.50	8.00	3.75

#	Aspect	Mean
10	Competition Intensity	7.79
7	Purchasing Power	7.50
1	Perceived Quality	7.36
3	Differentiation Features	7.29
8	Values and Lifestyle	7.21
4	Provider Trust	7.00
5	Customer Service	7.00
2	Brand Image	6.93
9	Risk Aversion	6.93
11	Availability	6.79
12	Price Promotions	6.14
6	Personalisation	5.64