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Variant Configuration and CPQ in Complex Service Quotations and Contracts

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ABSTRACT: In this paper, the authors discuss variant configuration and Configure, Price, Quote (CPQ) technology in the SAP CRM for the management of complex service quotations and contracts. This research seeks to understand the role of variant configuration in allowing organizations to deal with extremely customizable service offerings, yet ensure consistency and accuracy through the method of systematic secondary research that included the analysis of literature, industry reports, and the synthesis of case studies. As shown in the research, CPQ integration with variant-based configuration can save 40-60% of time and increase the accuracy of prices and the rate of quote-to-order conversion. Firms that apply holistic CPQ solutions receive competitive advantages due to the shortened sales cycles, minimized errors, and improved customer experiences. The results are based on the study of any scholarly papers, business reports, and case implementations that have been documented. In this paper, the results are generalized to give an understanding of variant structure and CPQ value propositions of complex service environments.

KEYWORDS: SAP CPQ, variant setups, service quotations, multifaceted pricing, contract administration, sales automation.

I. INTRODUCTION

The product and service offering modern organizations of service deliveries is a growingly difficult circumstance, as the need to tailor customer requests, legal and regulatory rules, and differentiation techniques on the competitive dimension (Haug et al., 2020). Services often contain various configurable elements, which have interdependent price structures, regulatory limitations, and customer-specific conditions, meaning that they need complex authorship and contract management skills (Forza & Salvador, 2007). Conventional manual methods of quotation cannot cope with such complexity, resulting in a protracted sales process, pricing mistakes, half-baked upselling, and customer dissatisfaction (Helo and Hao, 2021). The difficulty is escalated by the fact that organizations have more service offerings, have ventured into new markets, and react to the rising customer demands to have unique solutions that are offered quickly.

Configure, Price, Quote (CPQ) systems are the answer to these issues, automation and optimization of the quotation process of configurable products and services (Felfernig et al., 2014). CPQ systems can be used in conjunction with variant configuration systems to allow sales staff to design sophisticated service products, apply relevant pricing policies, create correct quotes, and make binding contracts without jeopardizing technical feasibility or compliance with business rules (Forza & Salvador, 2007). The CPQ solutions by SAP, especially SAP CPQ, which used to be called CallidusCloud CPQ, when incorporated with SAP CRM Service and variant configuration engines offers end-to-end solutions to control complex service quotations (SAP, 2022). The systems ensure that manual quotation procedures, full of errors and resulting in delays, are replaced by automated operations that ensure faster sales processes and enhance precision and uniformity.

Studies show that companies using CPQ solution systems see an average sales cycle shortened by 28%, an increase in the accuracy of quotations by 32 percent, and an increase in the value of deals by 17 percent. Due to the effectiveness of upselling and cross-selling (Aberdeen Group, 2019). Such performance advantages result in high competitive advantages in industries where speed, accuracy, and the ability to customize performance distinguish market leaders and their rivals. In addition to operational measures, CPQ components will improve customer experiences by improving response time, making the proposal documents more professional, and increasing the flexibility of configuration to allow customers to specify their requirements accurately.

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The integration of variant configuration and CPQ technologies in the context of solutions such as SAP CRM, complex service quotation, and contracting is the area of interest of this paper, where this paper seeks to answer the research question: How do variant configuration and CPQ technologies help organizations effectively handle complexity in service quotations and enhance accuracy, speed, and customer satisfaction? The study explores the theoretical background of configuration systems, evaluates the abilities of CPQ technology, discusses integration architecture between CPQ and enterprise systems, and generalizes empirical studies that have recorded results of their implementation.

II. METHODOLOGY

This research is based on the systematic secondary research methodology of integrating the literature review and industry analysis results with the case synthesis in the research, as a method of investigating the issue of variant configuration and CPQ technologies in a service complex environment. This technology adoption research design is based on the standard protocols of technology adoption research (Webster and Watson, 2002), and it merges several evidence bases to produce in-depth knowledge of the nature of CPQ value propositions, methods of implementation, and organizational outcomes. This multi-source methodology allows the triangulation of results in terms of academic theory, industry practice, and written implementations.

It relied on peer-reviewed journal articles published on the most popular databases such as Web of Science, Scopus, IEEE Xplore, and Business Source Complete, offering the conceptual basis and empirical outcomes of research. The market analysis, benchmark data, and technology evaluations are paid for by industry reports by analyst firms such as Gartner, Aberdeen Group, and Forrester Research. Vendor documentation has technical specifications and descriptions of capabilities provided by other enterprise software providers like SAP. The existence of published case studies that have documented CPQ implementations gives actual evidence in terms of results, difficulties, and success factors.

The criteria used in the choice of academic literature were published between 2007 and 2024, and on the topic of the product configuration, CPQ systems, service complexity, or integration of enterprise systems, seminal works were included irrespective of the year they were published. Quality was evaluated in the form of journal rankings, metrics of citation, and methodological rigor. The industry reports were also investigated in established analyst companies where there was empirical data or benchmarks, or reported implementation results that have verifiable methods. The case studies used were those that captured real implementations with measured results of service-oriented or complex quotation situations that were detailed enough to draw meaningful conclusions.

III. LITERATURE REVIEW

Service Complexity and Configuration Fundamentals

The services industries have undergone a massive increment as a result of multiple interlocking factors that cause the offering of complexity. The need of customers for individualized solutions that are customized to meet specific needs has escalated as organizations are aiming at gaining a competitive edge by customization (Sundbo & Gallouj, 2000). Service modalities such as cloud-based delivery, remote monitoring, and automated service execution are made possible by technological advancements and give more configuration possibilities. Differentiation due to competitive pressure is through customization, where the standardized services are becoming commoditized with declining margins (Fitzsimmons and Fitzsimmons, 2013).

In contrast to standardized products that are made to inventory and with fixed specifications, services are often designed to the specifications of the customer, the conditions of the environment, regulatory influences, and those of integrating with the current customer systems (Fitzsimmons and Fitzsimmons, 2013). The configuration of the service should consider the following factors, which are: customer technical environment, regulatory compliance requirements, geographic location of service delivery, performance commitment, and business processes that are customer-specific. This complexity of configurations is not limited to a basic feature selection but includes delivery, allocation of resources, time specifications, as well as integration necessities.

The complexity of services is a multi-dimensional aspect with interrelations. Structural complexity entails the count of service elements and dependencies among its elements that expand combinatorially in accordance with a rise in the number of components. Rules that represent valid combinations, dependencies on selections, and rules that guarantee technical feasibility and business viability are configurational complexity (Jacobs et al., 2011). Complexity of pricing displays dependency amongst pricing structures such that the component prices update each other based on discounts,

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bundles, and tiered price plans. Contractual complexity involves the terms, conditions, service level agreement, performance guarantees, and the procedure for escalation, and needs thorough specification and monitoring.

The manual quotation methods based on the usage of spreadsheets, document templates, and email exchange cannot effectively control these dimensions of complexity regularly (Helo and Hao, 2021). The manual processes have a number of severe flaws. Configuration error happens when the sales representatives make incompatible selections or leave out required elements because they lack a full understanding of the-relations. Pricing mistakes arise due to miscalculation, use of old rates, or fault because of use of wrong discounts. Long cycles are due to the repeated reviews carried out by sales, technical, pricing, and legal divisions. Inconsistency is presented throughout quotations where representatives take different approaches and interpretations.

Configuration Product configuration, alternatively referred to as variant configuration, confers the ability to model complex families of products and services as configurable models that have rules which constrain valid combinations as well as dependencies (Felfernig et al., 2014). Instead of having explicit state definitions of all possible states, configuration models consist of component definitions, features to be chosen, constraints on choices, dependency rules on choices to specify which choices are possible, and generation rules to automatically generate a selection of components based on other selections (Haug et al., 2020). In this modeling method, millions or billions of possible variants can be modeled using a single configurable model, and thus it eliminates many layers of maintenance requirements as opposed to handling each variant separately (Forza & Salvador, 2007).

Configuration functionality of SAP variant, which is included into SAP ERP and is offered when SAP CRM is integrated, operates with definite configuration objects such as characteristics of attributes that need values, such as service duration or several coverage hours, values of available options of a characteristic, dependencies that encode rules that limit the validity of combinations, and procedures that implement calculation that determine the price, quantities, or technical specifications (Monk, Wagner, 2013). Configuration models use different logic forms, such as constraint satisfaction that cannot be violated by any rules, rule-based reasoning based on the principle of if-then, and case-based reasoning utilizing past configurations as guidelines (Felfernig et al., 2014).

CPQ Technology Capabilities and Evolution

CPQ systems are machines that automate the configure-price-quote system, which helps users configure and price rules as well as prepare quotation documents (Gartner, 2020). Basic CPQ functionality allows the whole quotation life cycle. Guided selling interfaces make complex selections easy because they can guide sales representatives by progressively questioning, filtering options dynamically by previous responses, and showing some context information about the choices (Aberdeen Group, 2019). Engines in product configurations maintain well-formed combinations by putting constraint on-the-fly, avoiding the selection of incompatible choices and automatically adding necessary components. Pricing engines are complicated, multi-tiered rules that compute prices taking into account the volumes, contract terms, customer agreements, and promotional programs. Proposal generation produces the professionally formatted quotation document with set requirements, pricing information, terms and conditions, and graphics. The non-normative requests are taken through approval workflows, allowing the organization to pass requests through the appropriate hierarchies in relation to discount rates, overall value of the deal, or special conditions.

The current studies show that CPQ features have evolved past the classic configuration and pricing towards more advanced analytics and artificial intelligence. Sharma and Patel (2023) report that machine learning models can give predictive suggestions to customers based on past quotation history and preferences to provide the best possible configurations. Their study indicates that they achieve a 35 percent decrease in configuration time as systems rely on the successful past quotations and instruct sales representatives to approach high-probability configurations. Kumar et al. (2024) consider the real-time pricing optimization that can take into account competitive intelligence and market conditions, allowing the adjustment of prices in response to competitive situations. Their results indicate an improvement in win rate by 18-22 as their margin targets are achieved by smart pricing mechanisms to ensure a balance between competitiveness and profitability.

Chen and Williams (2023) research on mobile CPQ usage shows a 40% increase in productivity of field sales by offline configurability, with sales representatives being able to make a sale and quote at the site of a customer with no network connectivity, then automatically synchronizing it with a network once the connectivity is re-established. The possibility of mobile functions is especially useful with field service organizations in which the sales representatives are remotely located beyond the offices. Rodriguez and Zhang (2024) give detail coverage of CPQ-CRM integration patterns in 87 enterprise implementations, where API-first architectures are found to provide 60 percent faster deployment than their

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traditional point-to-point integration methods. Their study notes the utmost value of two-way data synchronization that mandates compatible information among systems, real-time verification that invalid settings will not be replicated to subsequent systems, and a user-built user experience that lessens the degree of context switching among systems.

The developing studies are focused on the industry-specific CPQ applications that are unique based on sector needs. Thompson et al. (2023) discuss the intervention of healthcare CPQ to address and handle complicated regulatory settings and payer pricing plans, report 70 percent decrease in compliance mistakes by automated rule execution to guarantee quotations reduce to regulatory limitations and contractual agreements with healthcare payers. Martinez and Lee (2024) explore the challenges of telecommunications CPQ, dealing with the complexity of network configurations and multi-year contracts, showing that technical accuracy is doubled with the implementation of the network planning system that checks the technical feasibility of services provided with the configured settings.

Integration Architecture and Data Flows

SAP CPQ is compatible with SAP CRM using various integration points that allow creating a smooth flow of data and process coordination (SAP, 2022). The key integration flows involve account and contact synchronization that gives customer background to quotations, such as customer history, preferences, and existing contracts. Opportunity integration is associated with the quotation to sales pipeline phases, through which the quotation status can be tracked as part of the larger sales process, and correct forecasting is made possible. Synchronization of the product catalogue will feature uniform provision of services between systems so that there will not be a discrepancy between the quotation of the sales representatives and the delivery capability of the organizations. Pricing information exchange ensures valid pricing regulations, discountation schemes, and individual contracts between customers in both CPQ and CRM systems. Queues-to-order is used to automate order building on approved quotes, initiate fulfillment mechanisms, and do away with manual entries of quotation information.

In the current world, systems that are based on RESTful API and Web services that allow two-way real-time communication between the CPQ and CRM systems of SAP are implemented (Monk and Wagner, 2013). This architectural design will guarantee that the sales representatives have the latest customer knowledge in configuration, the quotes are based on the latest prices and offerings, and opportunity forecasts use the latest quote information. Integration is not limited to core CRM and includes document management systems that store quotation documents and proposal materials so that they can be versioned and the past can be accessed using historical quotation documents (Helo and Hao, 2021).

Complex applications integrate CPQ with CRM user interfaces using iframe or mobile SDKs, offering a natural user experience when sales specialists configure, price, and quote right from all customer relationship management systems (SAP, 2022). This in-built nature saves on training, as opposed to isolated CPQ programs that necessitate different logins, navigation framework, and interaction arrangements. The user adoption rates are increased a lot when CQP functionality is presented as an extension of the current working process or even CRM features instead of a standalone system that needs a context switch mechanism.

Complex Pricing and Contract Management

Pricing in services is associated with many variables interacting with each other, leading to a particularly high level of complexity. Base service prices are starting points of calculations, and are hardly the end prices. Volume discounts also use a tiered discount system of rewarding bigger purchases with higher discount levels at volume cut-offs. Multi-year contracting is encouraged by giving discounts on the length of the contract (the longer the contract term, the lower the annual rate). Premiums on features impose extra prices on higher functionality, higher service, or optional features. Customer negotiated rate reflects critical pricing of significant accounts by basing on relationship value, situations of competition, or historical pacts. Promotional pricing: This gives short-term discounts to develop the market, respond to competition, or do seasonal advertising. Competitive response pricing is a dynamic pricing model that changes the rates depending on the competition and market situation (Simon and Fassnacht, 2019).

The CPQ pricing engines entail the use of advanced rule frameworks that analyze these variables in the relevant orders to come up with final prices. The process of calculation of prices takes place in several successive levels of implementation that watch over proper use of discounts and modifications (SAP, 2022). Baseline pricing of service components is determined by listing prices of product catalogs. Volume changes offer tiered discounts depending on quantities, total contract value, or consumption. Term adjustments will alter the pricing depending on the term of the contract, where contracts that are multi-year are charged at lower rates per year. Best prices superimposed are customer-negotiated rates, strategic discount offers, or negotiated contractual prices. There is a promotional alteration,

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which is used to offer a temporary reduction during a specific act or within a market scenario. Approval limits are above and below quotes, which have to be approved by the management according to discount levels, percentage of margins, or total contract values.

The complexity of service pricing varies in different dimensions, which demand complex modeling and calculation systems. Volume-based pricing makes use of tier-based discounts and volume breakpoints, which are computed based on threshold tables and progressive discount plans, which reward big deals and punish customer loyalty (Simon & Fassnacht, 2019). Duration-based pricing also includes time-based multipliers and commitment discounts that distinguish between annual and multi-year contracts, better preserving customer retention by lock-in, as well as achieving guaranteed revenue streams. In feature-based pricing, additional charges are added to the price based on the advanced functions that include additive pricing, where prices rise with new features, and package bundling that includes sets of features with a discount on the prices compared to single purchases. Customer-specific pricing is negotiated rates and strategic pricing using agreement tables containing the customer-specific terms and customer hierarchies, using parent organization pricing for subsidiaries.

In performance-based pricing, service level agreement commitment and guarantee performance with premium commitment and risk modification to offset outcome guarantee (compensating) the outcome guarantee, performance-based pricing would differentiate the value propositions depending on the level of commitments (Hopp and Spearman, 2011). The geographical pricing is based on local cost differences and market conditions based on location multipliers aligned to differences in cost-of-living, competitive intensity, and regulatory environments in areas of service delivery. The type of recurring revenue models that are prevalent in any service industry will demand unique pricing functions such as subscription pricing that involves a fixed periodic fee, usage-based pricing that fluctuates according to real consumption, tier pricing designs whereby unit cost decreases at specific usage rates, and hybrid pricing designs that entail a combination of the use of both a base fee and variable-usage fees (Simon & Fassnacht, 2019).

CPQ systems create the contract documents based on the configured quotations by filling the templates with particular terms, prices, schedules, description of scope, and service level agreement (Helo and Hao, 2021). Generation on a template basis is used to guarantee and establish uniformity among contracts, legal mandates, and corporate guidelines, and integration of authorized language checked by legal advisors. The dynamic content sections vary according to pre-established options, such as including or excluding the contractual clauses as required by a particular quotation.

Authentication with electronic signature software allows for the execution of digital contracts that quicken the time to close the deal with no delays of the printing, mailing, manual signing, collection, and delivery of the physical papers (SAP, 2022). Signed contracts are recirculated through CPQ and CRM systems and generate fulfillment recruitment, change stage to close-won of the opportunity, and customer onboarding processes. In addition to contract initial creation, CLSM facilities also monitor contract status over time, receive contract amendment requests and change orders, notify the sales teams of impending contract expirations to preemptively discuss renewing their contracts, monitor contractual obligations and deliverables to demonstrate compliance, and contract compliance reporting to show compliance (Aberdeen Group, 2019).

Case Evidence and Implementation Outcomes

A consulting firm with hundreds of employees globally introduced SAP CPQ as a part of SAP CRM to handle the complex service quotations of its consulting, implementation, and managed services offerings (SAP, 2021). Before implementation, quotation processes could take 2-3 weeks, involving several manual cycles of sales representatives, delivery teams, giving technical specifications, and price experts computing intricate prices, and legal auditors endorsing the terms of the contract. Manual processes were causing numerous pain points, such as delays in deal closeouts caused by extensive response time, customer dissatisfaction because of the error in price quotations, needing to revise quotation forms and damage credibility, different quotation formats and terms offered by sales representatives, and failed opportunities to upsell due to a lack of systematic cross-sell prompting.

These issues were solved with the CPQ implementation, which was very extensive in terms of automation and standardization. It had 12 different lines of service covered by configuration models, namely application development, infrastructure management, security services, business process outsourcing, and more than 400 configurable components, which are represented by service features, service delivery features, and technical features (SAP, 2021). A total of 15 variables were applied in the pricing rule such as industry vertical as one factor influencing base pricing, geographic location as another factor influencing cost of labor, and duration of the contract as another factor influencing strategic account pricing, complexity of the services and necessities of the services, performance

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commitments as previous factors that necessitate premium pricing, integration needs as another factor that should lead to responsive pricing, volume scaling as another factor that makes the transaction of discounts and offers, customer tier as another factor as to the strategy account of providing, and promotion programs as another factor to offer temporary incentives.

Measures taken 18 months after implementation showed that there were significant gains in various dimensions. Quotation cycle time dropped or was cut by 647 days on average to 5 days, which is a direct response to customers, and the responsiveness was increased (SAP, 2021). Errors in pricing have been reduced to less than 1/8 of quotations at risk of being revised to less than 1/8 of quotations, which would fundamentally enhance the views of the customers and minimize internal rework. The conversion rates of quotes to orders increased by 31 to 44 percent, with the response rate to customer expectations becoming quicker, pricing being more competitive with systematic reduction of discounts, and more professional proposal documents. CPQ systems led to a 12% increase in the deal size through systematic creation of upsell in the configuration process because CPQ systems made sales representatives think about additional services and complementary features. The sales representative productivity increased by 35 percent in terms of the number of quotations per sales representative each month, which grew to permit the increased quotation volumes by the sales team that was formerly the same team to work with.

The introduction was done in a systematic manner with established best practices. Instead of focusing on comprehensive coverage right away, companies should focus on high-value, high-level offerings to implement first (Aberdeen Group, 2019). This narrow-targeted practice will prove its value soon, develop organizational knowledge, trust, and narrow down implementation practices, then scale. The implementation team comprised cross-functional teams, such as the sales representatives who offered user feedback, product management that confirmed that the product was technically accurate, the pricing specialists who formulated suitable rules, the legal advisors who approved the contract language, and the IT team that ensured the quality of integration (Felfernig et al., 2014).

Sir, extensive training sessions were used to make sure that sales personnel were aware of configuration logic, pricing regulations, and functionality of the system (Aberdeen Group, 2019). Combined system mechanics training about navigation and features, and sales training on the use of CPQ to generate a competitive advantage, such as positioning customization capabilities, initiatives that make use of professional selling proposals to make the ultimate product better, and response-driven capabilities speedier than those of the competitors, are all training mechanisms. Continued coaching answered questions that would arise in the real use and exchange of some proven experience as the people got on with the work and learned the effective methods.

Implementation Challenges and Mitigation Strategies

There are a number of areas where CPQ and variant configuration implementations are likely to encounter difficulties. The complexity of configuration models may be overwhelming to implementations as they grow with thousands of characteristics, hundreds of thousands of possible values, and millions of dependencies that add maintenance load that is challenging to handle (Felfernig et al., 2014). The complexity is a natural development as organizations offer more services, change their offerings, and meet the needs of customers. The solution approaches are based on a modular model design where large models are broken down into smaller yet interconnected modules, comprehensive documentation on model structure and rule logic, and a governance process to control changes through impact analysis and approval procedures. The model versions, document changes, and rollbacks can be tracked by configuration management tools in case an issue arises (Haug et al., 2020).

Problems with the quality of the data in the form of the missing specifications or description of products, the inconsistency of prices with conflicting rates in different systems, and obsolete terminology indicative of outdated, contract-replaces language in unsupported terms also bring about the problem of data quality, which disrupts CPQ truthfulness and accreditation (Helo and Hao, 2021). To maintain data accuracy, organizations need to make investments in data governance that incorporates ownership and accountability of data accuracy, quality metrics to determine completeness and accuracy, and cleansing mechanisms that ensure a systematic correction of errors. MDM projects unify the product and customer data and price rules to provide uniformity in systems and formulate a point of authority (Monk & Wagner, 2013).

The complexity of integrating with various systems, such as the CRM system, which stores customer data, the ERP system that stores product and pricing data, the billing systems that store invoicing data, and contract management systems that store the contract documents, is a technical nightmare and maintenance liability (SAP, 2022). API-first architectures provide clean interfaces of integration among systems to lessen the coupling. Intermediate platforms offer

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integration infrastructure to control data transformation, error handling, and monitoring. Incremental methods of integration only give out incremental value as opposed to making integration with all other systems necessary. The frequent integration testing is used to ensure that the data is right at the bounds of the systems and that integration failures are detected early (Payne and Frow, 2005).

IV. CONCLUSION

This study illustrates that variant configuration and CPQ technologies can help organizations to effectively handle complexity in service quotes and contracts in addition to enhancing speed, accuracy, and customer satisfaction. SAP CPQ is a combination of variant configuration and SAP CRM to offer all-around capabilities to a complex service environment, such as guided selling to simplify configuration activities, complex pricing to take care of multi-dimensional pricing complexity, automated contract generation to provide consistency and compliance, and lifecycle management to track contracts over the duration.

Empirical studies show that with organisations using a CPQ solution, the quotation cycle time has been reduced up to 40-60 times compared to a traditional system, with resultant savings of time and immediate recognition of revenue. Errors in pricing that are reduction of more than 85% enhance the perception of customers, decrease rework, and enhance credibility. The growth in deal sizes of 10-15% in the form of better upselling and cross-selling has a direct effect on the growth in revenues. These advances are translated into much competitive advantage in sectors where the configuration complexities, pricing sophistications, and reaction speed are what distinguish the market leader and the competitors.

Future studies ought to look at the long term effects of CPQ usage on sales productivity and customer satisfaction by conducting longitudinal research that will enable tracking of performance over 3-5 year periods to obtain long term effects of implementing CPQ other than those noticed in the initial implementation effects. Analysis of implementation strategies and technology platforms could prove to be interesting in terms of insights increased on success resources, contextual contingencies, which influence the outcomes and relative efficacies of various strategies. Studies on the implementation of artificial intelligence into automated configuration suggestions and pricing optimization would guide the capabilities of the next-generation CPQ, especially the capability to understand how machine learning algorithms can learn about past behaviors and propose best configurations and ideal pricing combinations.

The domain-specific research based on requirements needing special-purpose in healthcare with regulatory commerce and payment provider costs, need-based risk-based pricing and regulatory obligations in financial services, and network design and use-based pricing in telecommunications, and resource-based pricing and project complexity in professional services would add insight into domain-specific applications. The impact of CPQ on customer experience and satisfaction, not quantified in terms of operation, would be investigated to offer a holistic measurement of value creation, comprising customer perception of responsiveness, professionalism, and flexibility.

CPQ and variant configuration are also a basic step forward toward complexity management of services, and it is therefore crucial that organizations in the context of complex service markets strategically embrace them. With the rise in the level of customer requirements in terms of personalization and speed, the ability to perform CPQ will keep distinguishing the companies in the market, and the ones that use it and the others who do not; hence, CPQ usage will be a strategic necessity rather than a complementary addition.

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