



Andrey Saltan

REVEALING THE STATE OF SOFTWARE-AS-A-SERVICE PRICING



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Abstract

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The transition towards cloud computing is transforming the way software solutions are designed and developed, priced and packaged, as well as delivered and maintained. Software companies are moving away from the traditional model of selling software solutions as off-the-shelf software products to providing Software-as-a-Service (SaaS) solutions. This transition unlocks unique opportunities for reconsidering product and marketing strategies, including pricing. The fundamental changes that affect pricing are the adoption of value-based and subscription-based approaches. Both of these create challenges for product and pricing managers, and only a handful of software companies succeed in taking advantage of all the opportunities the SaaS model offers.

This dissertation explores how software companies establish and implement the pricing of their SaaS solutions. This research aims to reveal the nature of pricing for SaaS solutions and empower SaaS companies with the knowledge required to advance their pricing processes and practices. The dissertation consists of four studies that employed a portfolio of research methods, including a simulation modeling, a multivocal literature review, a multiple case study research, and an industry survey.

The contribution of this dissertation is threefold. First, the dissertation bridges the gap between scholars and practitioners and proposes a typology of SaaS pricing aspects, affecting factors, frameworks, and structures. It updates the knowledge and expertise in the SaaS pricing area of research and practice. Second, the dissertation reveals how SaaS companies price their solutions by evaluating industrial practices and exploring the reasons behind them. This allows proposing a typology of SaaS pricing practices. Thirdly, an integrated simulation model of SaaS pricing is put forward to analyze dynamic pricing mechanisms. This model serves as an example of how different pricing mechanisms and factors can be explored to improve decision-making in SaaS pricing.

Ultimately, this research should contribute to a reduction in the market failure risk for technologically advanced SaaS solutions. The result of the research indicates a lack of silver-bullet solutions for pricing, meaning that it should not be left to intuition and performed in an ad hoc manner. On the contrary, pricing requires efficient collaboration between different business units and a comprehensive analysis that incorporates experimentation, data analytics, and modeling.

Keywords: Software-as-a-Service, SaaS, pricing, multivocal literature study, case study, SaaS product management

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There is an old saying: “We plan, God laughs.” I can fully appreciate this proverb as my Ph.D. journey is an excellent example of something which was thoroughly planned out but happened to take quite a crooked route with rather unexpected twists and turns. I was lucky that I was not on my own in this journey, there were always people who helped me to get through all the challenges and achieve the goal.

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List of publications

This dissertation is based on the following original publications, referred to in the dissertation as Publications I, II, III, and IV.

For all of the included publications, Andrey Saltan was the principal contributor with regard to research design, planning, execution, and publication writing. Publication I was reviewed by Ahmed Seffah and Uolevi Nikula. To ensure the reliability and validity of the results, work on Publications II to IV was guided and reviewed by Kari Smolander, a supervisor of Andrey Saltan.

The corresponding publishers have granted the rights to include the following publications in the dissertation.

- I. Saltan, A., Nikula, U., Seffah, A., and Yurkov, A. (2016). A Dynamic Pricing Model for Software Products Incorporating Human Experiences. In: *Maglyas, A. and Lamprecht, A.-L. (eds.). 7th International Conference on Software Business, ICSOB 2016. Lecture Notes in Business Information Processing*, vol. 240, pp. 135–144. Springer.
- II. Saltan, A. and Smolander, K. (2021a). Bridging the State-of-the-Art and the State-of-the-Practice of SaaS Pricing: A Multivocal Literature Review. *Information and Software Technology*, vol. 133, 106510.
- III. Saltan, A. and Smolander, K. (2021b). How SaaS Companies Price Their Products: Insights from an Industry Study. In: *Klotins, E. and Wnuk, K. (eds.). 11th International Conference on Software Business, ICSOB 2020. Lecture Notes in Business Information Processing*, vol. 407, pp. 1–13. Springer.
- IV. Saltan, A. and Smolander, K. (2021c). SaaS Pricing Practices Typology: A Case Study. In: *Gregory, P. and Kruchten, P. (eds.). Agile Processes in Software Engineering and Extreme Programming – Workshops. XP 2021. Lecture Notes in Business Information Processing*, vol. 426, pp. 1–9. Springer.

Related publication (not included in this dissertation)

This dissertation also builds on other related publications, which were not included in the dissertation portfolio of publications.

- I. Saltan, A. and Smolander, K. (2019) Towards a SaaS Pricing Cookbook: A Multi-Vocal Literature Review. In: *Hyrnsalmi S., Suoranta M., Nguyen-Duc A., Tyrväinen P., Abrahamsson P. (eds.). 10th International Conference on Software Business, ICSOB 2019. Lecture Notes in Business Information Processing*, vol. 407, pp. 114–129, Springer.
- II. Saltan, A. (2019) Do We Know How to Price SaaS: A Multi-Vocal Literature Review. In: *Proceedings of the 2nd ACM SIGSOFT International Workshop on Software-Intensive Business: Start-ups, Platforms, and Ecosystems (IWSiB 2019)*, pp. 7–12.

- III. Saltan, A., Jansen, S., and Smolander, K. (2018) Decision-Making in Software Product Management: Identifying Research Directions from Practice. In: *Proceedings of the International Workshop on Software-intensive Business: Start-ups, Ecosystems and Platforms (SiBW 2018)*, pp. 164–176.
- IV. Saltan, A. and Seffah, A. (2018) Engineering and Business Aspects of SaaS Model Adoption: Insights from a Mapping Study. In: *Proceedings of the International Workshop on Software-intensive Business: Start-ups, Ecosystems and Platforms (SiBW 2018)*. pp. 115–127.

Nomenclature

B2B	Business-to-Business
B2C	Business-to-Consumer
B2G	Business-to-Government
GL	Grey Literature
MLR	Multivocal Literature Review
NIST	National Institute of Standards and Technology
PEC	Preliminary Empirical Conclusion
PICO	Population, Intervention, Comparison, Outcomes
PRQ	Principal Research Question
RQ	Research Question
SaaS	Software-as-a-Service
SIIA	Software & Information Industry Association
SME	Small and Medium-sized Enterprises
WL	White Literature

1 Introduction

The introduction summarizes the motivation for the research, its objectives, research questions, methodology, and contribution. It also explains the organization of the chapters in the dissertation.

1.1 Research Motivation

Software-as-a-service (SaaS) is a software licensing and delivery model in which customers can access application software through an interface over the Internet. Customers are not supposed to buy perpetual licenses or install, run, and maintain software on their own devices and servers. Despite the many challenges of adopting the SaaS model (Asatiani, 2015), SaaS has become an integral part of today's software and Information Technology (IT) landscape. While SaaS has entered its second decade, its market potential is far from being achieved. Industry analytical reports predict that SaaS market revenue will continue its annual growth of up to 25%, crossing the \$200 billion threshold by 2025 (Costello and Rimol, 2021; Mlitz, 2021; Technavio, 2021).

The transition towards the SaaS model also brought challenges to software companies, which had to reconsider their product management and development practices and processes, including a complete revision of pricing (Saltan and Seffah, 2018). In the context of this dissertation, SaaS pricing will be defined as the process of decision-making to determine the monetary compensation and related conditions for the software services the customer is offered. Software companies, including SaaS providers, repeatedly recognize pricing as an essential element of business strategy and model with a direct and significant impact on the commercial success of the offered software solutions. However, establishing value-based pricing grounded in the pay-per-use subscription models required for SaaS solutions created challenges for many software companies facing a lack of resources and understanding of how to design and implement pricing properly.

Challenges related to SaaS pricing are diverse and nuanced. Firstly, pricing requires coordination among the many business functions involved. For SaaS solutions developed in an agile environment and distributed on a subscription basis, the teams and business units responsible for the engineering and business aspects of the delivered solution are more interdependent than they used to be for off-the-shelf perpetual licensed software products. Secondly, a myriad of factors and options should be considered while designing and implementing pricing for SaaS solutions. As a result, efficient and informed decision-making needs to be grounded in sophisticated statistical and economic analysis using multiple data sources. Finally, pricing for SaaS solutions cannot be conclusively defined but should be continuously revised and adapted to external and internal factors. With all these challenges, pricing remains a scattered and under-managed process in many SaaS companies, especially when it comes to small and medium-sized SaaS providers.

Since its inception, the business and marketing aspects of the SaaS model, including pricing, have become topics of interest for researchers in economics, management and marketing, as well as software engineering and computer science. However, the lack of a single “home” for studies on SaaS pricing has led to isolated research on pricing in the SaaS context, with diverse and inconsistent outcomes in the form of approaches, models, and recommendations. As a result, the existing body of research does not provide solid ground for practitioners in designing and implementing the pricing of SaaS solutions.

The identified lack of integration between different research domains focused on SaaS pricing and, more importantly, between academia and industry is the main driver for the current research and is systematically addressed throughout the studies included in this dissertation.

1.2 Research Objective

As discussed earlier, the commercial success of SaaS solutions is heavily reliant on appropriate pricing, while decisions on designing and implementing pricing have always been challenging. This dissertation explores how software companies design and implement pricing for SaaS solutions and constructs an understanding of how SaaS pricing practices and processes can be improved.

The goal of the current dissertation is to bring SaaS research and practice a step forward by systemizing the current knowledge, closing the theory-practice gap, and providing SaaS companies with working solutions to support SaaS pricing decision-making. Ultimately, this dissertation shall enable companies to make pricing-related decisions grounded in rigorous research conducted using a portfolio of different methods.

1.3 Research Design

To get an integrated and transparent look into the theory and practice of SaaS pricing, this dissertation focuses on finding an answer to the following principal research question (PRQ):

PRQ: How do software companies establish and implement the pricing of their SaaS solutions, and how can the associated processes and practices be improved?

The PRQ can be further divided into the following research questions:

- RQ1: What is the status of the academic research and practical expertise in SaaS pricing?
- RQ2: What types of SaaS pricing practices can be identified in a real-life context?
- RQ3: How simulation modelling can support SaaS providers in pricing their products?

The combination of answers to RQ1–RQ3 provides an answer to the PRQ.

The dissertation was conducted using a portfolio of four research methods that include a simulation modeling, a multivocal literature review (MLR), a multiple case study research, and an industry survey. Table 1 summarizes the research questions and maps them to the publications included in the dissertation and the adopted research methods.

Table 1. Association of research questions with publications and research methods

Research Question	Publication	Research Method
RQ1: What is the status of the academic research and practical expertise in SaaS pricing?	Publication II	MLR
RQ2: What types of SaaS pricing practices can be identified in a real-life context?	Publication III	Industry Survey
	Publication IV	Multiple Case Study
RQ3: How simulation modelling can support SaaS providers in pricing their products?	Publication I	Simulation Modeling

An MLR approach was used to reveal the state-of-the-art and the state-of-the-practice of SaaS pricing, bridge them and explore the identified theory-practice gap. Combining the “white” and “grey” literature allows for the creation of a taxonomy of pricing-related concepts, classifying SaaS pricing aspects, the affecting factors, and the challenges facing SaaS providers. The findings and interpretations form a clear picture of SaaS pricing research and practice, emphasizing major research themes that require further investigation and practical challenges of pricing SaaS solutions.

An industry survey based on a revision of the pricing information of 220 SaaS solutions was carried out to explore how SaaS providers package and price their products. Existing pricing practices were classified and further analyzed through the prism of existing pricing theories. The survey allowed us to assess the extent to which the theoretical conclusions of researchers in the field of economics and management regarding software and SaaS pricing correspond with industrial practices.

A qualitative exploratory multiple case study of 15 SaaS companies was used to assess SaaS pricing practices and identify the main factors affecting the way pricing is managed. Data collected through a series of semi-structured interviews and document inspection allowed the identification of four distinct types of SaaS pricing patterns and their main characteristics. This qualitative exploratory case study complements the industry survey and allows an understanding of the logic and motivation behind SaaS pricing decisions observed in practice.

The agent-based simulation modeling was used to develop a model to assess the efficiency and effectiveness of using two dynamic pricing mechanisms – penetration pricing and skimming pricing. The simulation model is based on existing models in economics and management. The model can be further extended and used in performing complex analysis of SaaS pricing and product strategy.

1.4 Research Contribution

The goal of the dissertation is to obtain a better understanding of how the pricing of SaaS solutions can and should be organized, structured and performed. The contribution of this dissertation is threefold, as follows:

- First, the dissertation bridges the gap between scholars and practitioners and proposes typologies of SaaS pricing aspects, affecting factors, frameworks, and structures.
- Second, the dissertation disclosures how software companies implement the pricing of their SaaS solutions and reveals a typology of pricing practices in SaaS companies by observing industrial practices and performing interviews with companies offering SaaS solutions.
- Third, the dissertation shows what kind of simulation models can be used by SaaS companies and illustrates how companies can improve pricing decision-making by the example of dynamic pricing.

There is a keen interest in and need for better pricing methods and solutions in the software industry, which is experiencing a transition towards service-oriented and cloud-based paradigm. The dissertation provides a solid ground to expand and deepen the knowledge on the pricing of SaaS solutions even further, given that the SaaS model is here for the long haul. In the long run, the research presented in this dissertation can help create a beneficial environment for SaaS providers, which play an essential role in the modern software market with a steady growth over the past decades.

1.5 Dissertation Outline

The dissertation consists of six chapters.

Chapter 1 – Introduction – describes the overall dissertation, including the motivation behind the research, its main objectives and research questions, the overall research methodology, and the research contribution.

Chapter 2 – Background – presents the general landscape of the research area related to SaaS pricing and an overview of all the major aspects of SaaS pricing relevant for the current dissertation, as well as identifies the research gap that the dissertation attempts to fill.

Chapter 3 – Methodology – presents the research methodology adopted in this dissertation, including an explanation of the choice of research methods used and the sequence of the research steps.

Chapter 4 – Publication Overview – describes the findings generated by the research by providing overviews of the publications in the dissertation portfolio.

Chapter 5 – Discussion – summarizes the results, reflects on the theoretical and practical contributions, and outlines future research possibilities.

Finally, Chapter 6 concludes the dissertation.

2 Background

This chapter presents the background of the dissertation and the context of the problem domain. It starts with a brief history of and an introduction to the SaaS model as one of three prime pillars of cloud computing. Then, the role and place of pricing in SaaS companies are presented. This is followed by a discussion of the current state of the research on the topic, which sets the scope of the dissertation and reveals the research gap.

2.1 Software-as-a-Service Model

2.1.1 Historical Overview of SaaS

The origins of the SaaS model go back to 1961, when J. McCarthy first introduced the idea of delivering computer services in a way similar to telephone services through the utility business model. In the same year, the Compatible Time-Sharing System was revealed by the MIT Computation Center. The concept was later adopted and implemented by several mainframe computer companies, including IBM and General Electric. These companies started establishing computer service bureaus intended to offer services of time-based paid access to computing power, storage, and applications. Such services were assumed to be consumed by a diverse range of organizations, including commercial companies and educational institutions that did not have the resources and expertise to perform the required computation tasks internally (Attewell, 1992). However, by the 1970s, it had become apparent that the concept was ahead of its time from both the technological and business perspectives. The concept finally lost its relevance with the appearance of personal computers. The diffusion of personal computers and private servers accelerated the usage of the on-premise software model, which offered the ability to purchase a perpetual license and install a copy of the software on a local computer.

The development of the Internet development has led to the reconsideration of the concept of the computer service bureaus under a new name – application service provider (ASP). The acronym ASP was introduced by J. Eikeland in 1996 while discussing the emergence of the new software delivery and licensing model – the software lease model. Customers were entitled to use a wide range of software products via the Internet or a “thin client,” while the software solutions were hosted and maintained by ASPs. The provider operates and maintains the servers that run the software. The new model assumed bringing cost reductions to customers and relieve them from the need to purchase, install, and maintain software. Despite all the promise, the attractiveness of the idea itself, the software lease model did not prosper, and many companies founded on the ASP model did not succeed. For various reasons, the model was not widely accepted and adopted by all types of customers, from individuals to large corporations (Altaf and Schuff, 2010).

In the 2000s, with the further development of the Internet, the ASP model re-emerged under the notion of “software-as-a-service” and as part of the cloud computing paradigm.

The acronym SaaS itself was invented in 2001 by the Software & Information Industry Association (SIIA) (Hoch, Griffith and Kerr, 2001; Sääksjärvi, Lassila and Nordström, 2005). From the customer perspective, the two models mentioned above have a lot in common as both assume access to the hosted software solution. However, from the provider's perspective, the difference is quite significant. First, in most cases, SaaS providers develop their own software solutions, while most ASPs focused on offering third-party solutions purchased from software vendors. Secondly, SaaS providers gain access to their solutions using multi-tenant infrastructure architecture in which the software solution serves multiple customers simultaneously, while ASPs had to maintain a separate instance of the application for each customer. The unique engineering characteristics of SaaS, along with greater consumer readiness to work with hosted software solutions, ensured market success for SaaS providers and the rapid dissemination of the SaaS model.

2.1.2 Concept and Definition of SaaS

In 2001, SIIA defined SaaS as a model in where “the application, or service, is deployed from a centralized data center across a network – Internet, Intranet, LAN, or VPN – providing access and use on a recurring fee basis. Users ‘rent,’ ‘subscribe to,’ ‘are assigned,’ or ‘are granted access to’ the applications from a central provider” (Hoch, Griffith and Kerr, 2001). This definition captures the idea of the SaaS model but lacks essential engineering and business aspects.

Ten years later, the United States National Institute of Standards and Technology (NIST) offered their own definition, which has become the most common and generally accepted definition of SaaS (Mell and Grance, 2011). First, NIST defined cloud computing in general as “a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.” Further, SaaS itself was defined as one of three models along with platform- and infrastructure-as-a-service (PaaS and IaaS). Specifically, SaaS is “the capability provided to the consumer [...] to use the provider's applications running on a cloud infrastructure.” The applications are accessible from various devices through a thin client interface or an application. The consumer does not manage or control the underlying cloud infrastructure except for limited user-specific application configuration settings.

The NIST definition reveals the entire engineering essence of the SaaS model, focusing primarily on the deployment and delivery aspects of the model. However, it does not fully disclose the economic essence of the phenomena associated with the licensing part of the SaaS model. The following definitions offered by Gartner and four SaaS providers complement the NIST definition by highlighting the business aspects of SaaS model:

- **Gartner:** “Software as a service (SaaS) is software that is owned, delivered and managed remotely by one or more providers. The provider delivers software based

on one set of common code and data definitions that is consumed in a one-to-many model by all contracted customers at any time on a pay-for-use basis or as a subscription-based on use metrics” (Gartner, 2021).

- **Hubspot:** “SaaS stands for software as a service. It is a type of software hosted, secured, and managed by a single provider. It can be accessed online, easily customized, and is serviced and supported by the provider’s own product engineers and customer success team” (Prater, 2021).
- **Cisco:** “Software as a service (SaaS) is a delivery and licensing model in which software is accessed on the web via a subscription rather than installed on local computers. With SaaS, companies need not manage applications or invest in hardware to run their applications. Instead, a provider hosts and manages the infrastructure to support software, which enables updates and patches to be applied automatically and universally and reduces the burden on a company’s IT team” (Cisco, 2021).
- **Salesforce:** “Software-as-a-Service (SaaS) is a licensing and distribution model used to deliver software applications over the Internet i.e. as a service. Users typically access applications on a subscription basis, making SaaS ideal for business software such as email, instant messaging and customer relationship management (CRM)” (Salesforce, 2021).
- **Microsoft:** “Software as a service (SaaS) allows users to connect to and use cloud-based apps over the Internet. SaaS provides a complete software solution that you purchase on a pay-as-you-go basis from a cloud service provider. You rent the use of an app for your organization, and your users connect to it over the Internet, usually with a web browser. All of the underlying infrastructure, middleware, app software, and app data are located in the service provider’s data center. The service provider manages the hardware and software, and with the appropriate service agreement, will ensure the availability and the security of the app and your data as well. SaaS allows your organization to get quickly up and running with an app at minimal upfront cost” (Microsoft, 2021).

These definitions show how SaaS is conceived today with the unique processes and innovations behind this model. Looking for a common ground leads us to understanding that, in general, the SaaS model has the following five aspects:

- **On-demand measured self-service:** SaaS solutions are allocated automatically as required by the customers without any human interaction. Required resources and services are monitored, controlled, and optimized by SaaS providers.
- **Broad network access:** Customers can access SaaS providers’ resources over the Internet anytime and anywhere through different types of devices. Customers can fulfill all their needs through a net service using a laptop or a mobile phone.
- **Elasticity and scalability:** Computing resources can be rapidly and elastically provisioned and released based on customer demand. SaaS providers can add new servers with minor modifications to the infrastructure and software.

- **Multitenancy:** An SaaS provider delivers services to multiple customers at the same time. Those customers run on the same instance of a piece of software and share resources at the network level, host level, and application level without influencing each other or having access to each other's data.
- **Subscription-based pricing:** Customers are supposed to pay a recurring price at regular intervals to access the SaaS solution. The price is defined by usage- and user-based metrics. Besides access to the SaaS solution, payments cover all associated services (i.e., data storage).

2.1.3 SaaS Market Landscape

SaaS is primarily associated with B2B solutions, although it does not, as a term, explicitly refer to the B2B market. In the business-to-consumer (B2C) market, SaaS is seldom mentioned. Dividing the line between B2B SaaS and B2C services, including social networks, multimedia services, instant messengers, and news aggregators, is quite tricky. Similarly, both marketing and economic researchers who focus on the B2C market and the users/consumers of these services use expressions such as “cloud services” (Lei, Chen and Li, 2016), “online services” (Pang and Etzion, 2012), and “information services” (Balasubramanian, Bhattacharya and Viswanathan, 2015).

The SaaS market is populated with both new companies, established initially as service companies, and companies that entered this market from the traditional off-the-shelf software products market with software services developed based on existing software products (Labes, Hanner and Zarnekow, 2017). Companies of the first type followed the “development from scratch for SaaS” approach considering the features and capabilities of the SaaS model. In contrast, the second type were “re-engineering for SaaS,” with a plan either to supplement the already-existing on-demand software with specific SaaS solutions or to implement the full transformation within some period (Baliyan and Kumar, 2014).

The SaaS model brought a radical shift in how software is engineered and developed as well as its product strategy and pricing, lifecycle management, customer involvement, and relationship management (Stuckenberg and Stefan, 2012). SaaS pricing aspects and challenges will be discussed in the next section.

2.2 Software-as-a-Service Pricing

2.2.1 Foundations of Pricing

Consolidating the variety of different definitions provided by scholars and practitioners (Simonetto et al., 2012; Özer and Phillips, 2012), pricing can be defined as the process of decision-making in determining the monetary compensation and related conditions of the goods and services the customer is offered. Pricing is an essential element of the business model and product strategy. It serves as an essential bridge between different business

functions (i.e., product management, revenue management, cost management, retention management) and business units (i.e., R&D, production, sales, marketing). Decision-making in pricing is based on an integrated analysis of different perspectives and streams of information.

While price has been the central element of economic theories for centuries, the concept of pricing as a managerial discipline and business function dates to the late 1970s. It arose due to the deregulation of the airline industry, which provided flexibility for airline companies in defining prices for airline tickets (Morrison and Winston, 1990). Back then, pricing was considered as a part of revenue (or yield) management, defined as the processes and practices of selling “the right inventory unit to the right type of customer, at the right time, and for the right price” (Kimes, Phillips and Summa, 2012). Efficient revenue management required comprehensive decision-making regarding these four “right” aspects, intending to maximize revenue streams. Since then, a considerable amount of the management literature on revenue management has been published, exploring its evolution and variation among industries and even among companies within the same industry (Kienzler and Kowalkowski, 2017).

There are many approaches on how to design and systematize pricing. However, one of the first fundamental aspects of pricing is the choice of a pricing approach or strategy. Nowadays, it is common to distinguish between value-based pricing, market-based pricing, and cost-based pricing (Baur et al., 2014; Wu, Buyya and Ramamohanarao, 2020).

- **Value-based Pricing Strategy:** This pricing strategy is grounded in the value perceived by the customer. Perception-value is based on the customers’ perceptions of what is expected compared with what is delivered. The necessity to evaluate this value and associated challenges make this strategy much more subjective in comparison with other pricing strategies. The common term of perceptive value is value for money, that is, the ratio between the customer value of a cloud service and the price. The main advantage of value-based pricing is its subjective fairness for consumers who can compare their expenses with the benefits gained. However, it is challenging to construct because the perceived value is primarily measured by the satisfaction of the individual customer – that is, there can be strong heterogeneity among customers, which may require additional segmentation.
- **Market-based Pricing:** This approach is grounded in the analysis of the market equilibrium of demand and supply and market competition. Market-based pricing takes into consideration two kinds of impacts on pricing – price sensitivity and market competitiveness for similar services. Some researchers and practitioners suggest the distinction between competitor-based pricing and premium pricing as separate approaches from market-based pricing.
- **Cost-based Pricing:** This pricing strategy is grounded in the analysis of a cloud service provider’s cost structure. One of the primary reasons to adopt this strategy is that it is concrete and tangible. It can also be considered as “fact”-based pricing.

Cost-based pricing can articulate a unit cost and provide a measurement for benchmark comparison. It is one of the managerial tools for many decision-makers to drive business performance.

Additionally, not all the discussed pricing approaches are mutually exclusive, and many companies use hybrid approaches that combine features of different models. While all three pricing strategies exist in practice, their usage frequency is hard to estimate as a great deal depends on the context.

2.2.2 Pricing in the Software Industries

The software industry has unique characteristics of revenue, pricing, and cost management. First, revenue management in the software industry is mostly about defining the “right pricing” and the “right customers”. The production, logistics, inventory – another essential pillars of revenue management – are of little importance. Secondly, most software companies have a considerable disparity between fixed costs and variable costs, which creates supply-side economies of scale (Hoch et al., 2000; Kittlaus and Clough, 2009). Thirdly, the software industry is often characterized by network effects that make perceived value and willingness-to-pay (WTP) contingent on the actual number of customers (Katz and Shapiro, 1994; Buxmann, 2001). These three characteristics of software and the software industry confirm the role of pricing as a key driver for market success and revenue growth.

While the commercial success of software companies depends on adequate pricing, decisions on designing and implementing pricing have always been challenging (Bontis and Chung, 2000). As a result, quite often, companies make all the decisions regarding pricing as a part of the last development cycles and launch software without fully activating its pricing potential. Achieving the “right pricing” in software companies requires a tighter alignment between pricing management and development processes than in any other industry. Because of that, nowadays, pricing is considered an integral part of software product management, with the corresponding responsibilities falling on the shoulders of product managers (Kittlaus and Fricker, 2017).

For software products, many pricing experts emphasize the advantages of value-based pricing. The low variable costs for software products make cost-based pricing not directly applicable to software products. A monopolistic competitive market structure allows companies to move away from direct competition and avoid setting prices based on competitors or market equilibrium. However, many companies from the software industry still conventionally rely on cost-based and market-based pricing. The cost-based approach helps decision-makers set a baseline to charge customers a minimum price so that they can at least cover their expenditures. While market-based pricing allows companies to rely on market forces and consider the current situation as an equilibrium. If there is a lack of focus in pricing at the strategic, tactical, or operational levels, the product and the company are likely to fail.

2.2.3 Overview of SaaS Pricing

The transition towards the SaaS business model has enabled new opportunities for software companies in software development, delivery, and operation. These opportunities have implications for pricing – the business function connected to all activities concerning price. The price goes beyond the license fee for SaaS solutions and incorporates recurring service and maintenance fees (Cusumano, 2007). As a result, the role of customer relationship marketing has significantly increased, and pricing has become an essential instrument in customer acquisition, retention, and monetization. However, the downside of the transformation is the fact that old pricing principles and practices become obsolete.

While pricing is one of the most potent sources of competitive advantage and commercial success for SaaS solutions, in many cases, it is the least explored business function of companies offering SaaS solutions. The transition towards SaaS created and magnified the number of pricing design, experiment, and control mechanisms available. Examples of such mechanisms include but are not limited to recurring subscription fees, new methods to ensure efficient price discrimination, and real-time usage tracking (Dutt, Jain and Kumar, 2018). However, these new opportunities can also pose obstacles for companies as their understanding of how the new pricing processes and practices should be designed is unclear (Ojala, 2016). Efficient pricing requires sophisticated decision-making and analytics, as well as coordination and finding compromises between the many business functions involved. Facing these challenges, large software and tech companies offering SaaS solutions employ economists who cooperate with product and project managers to address all their products' pricing challenges (Athey and Luca, 2019). However, a wide range of newly established SaaS providers, most of which are small- and medium-sized enterprises, do not have the resources and knowledge to make informed decisions on pricing strategy, tactics, and implementation operations. A patchy knowledge of SaaS pricing and complications in establishing and managing all pricing-related processes and practices results in a scattered and under-managed pricing process for many SaaS providers.

Haphazard SaaS pricing is mirrored in the academic literature. Since its inception, SaaS and all its associated aspects, including pricing, have become topics of interest in various research domains, including economics, management science, and marketing, as well as software engineering and computer science. However, the lack of a single “home” for studies on software and SaaS pricing in the academic community has resulted in isolated pricing-related studies with diverse and inconsistent approaches and recommendations. As a result, the current theory does not sufficiently assist practitioners in selecting from among the many options when designing and implementing the pricing of their SaaS solutions.

3 Methodology

This chapter summarizes the research methodology by formalizing the overall research framework, presenting the research stages and associated research questions, and describing the research methods and sources of data used.

3.1 Selection of Research Methods

The Cambridge Dictionary defines research “as a detailed study of a subject, especially in order to discover (new) information or reach a (new) understanding” (Cambridge, 2021). This definition emphasizes the aim of the process related to the creation of new knowledge in the form of information or understanding. In the current dissertation, the new knowledge is related to gaining a better understanding regarding the specifics of pricing in the SaaS context and discovering information about current industrial practices.

The key to the success of academic research is primarily determined by the proper selection of the research methods applied to provide answers to the research questions and reach the research objectives using the available resources (Jarvinen, 2000; Kothari, 2004). The portfolio of selected research methods forms the research methodology and determine how the investigation will deliver the desired knowledge. In most situations, there is no standard methodology that applies to all sorts of research but rather the methodology has to be developed based on the nature and scope of the topic and question under investigation. The set of methods that can be used in studies is extensive and still growing (Brannen, 2017).

One crucial classification of research, essential to the choice of methods for the current study, assumes a distinction between exploratory research, aimed to explore patterns with no prior formulated hypotheses, and confirmatory research, which assumes the verification of already-formulated hypotheses (Jaeger and Halliday, 1998). The topic of the current dissertation emphasizes its exploratory nature in seeking to reveal the state of SaaS pricing instead of testing certain theories and hypotheses.

Within the exploratory research approach, a wide range of quantitative and qualitative methods are available (Goertz and Mahoney, 2012). Quantitative methods investigate phenomena by collecting quantifiable data in numerical form and applying mathematical and statistical models and techniques for data analysis. Quantitative research methods are often used to determine relationships between variables and to quantify the degree of these relationships. Examples of quantitative research methods include simulation and mathematical modeling, experiments, surveys, and structured observations (Kaplan, 2004; Little, 2013). In contrast, qualitative research produces findings by means different from quantification and modeling. Qualitative methods adopt a more holistic view that intends to obtain knowledge from involvement in the actual experiences. Studies employing qualitative methods often aim to obtain an in-depth understanding of the phenomena by exploring and interpreting collected non-quantified data by performing

thematic and content analyses. Examples of qualitative research methods include case studies, grounded theory, and ethnography studies (Knowles and Cole, 2008; Leavy, 2014).

Within the dissertation, a portfolio of qualitative and quantitative research methods was adopted to answer the PRQ: *How do software companies establish and implement the pricing of their SaaS solutions, and how can the associated processes and practices be improved?* Qualitative research methods such as case studies and MLRs were used to uncover the underlying logic of SaaS pricing and explore the theory-practice gap. Quantitative research methods such as structured industry surveys and simulation modeling were used to assess industrial practices and evaluate the feasibility of SaaS pricing mechanisms under particular product and market characteristics.

3.2 Research Methodology

In Publications I to IV, various research methods were adopted to derive answers for the RQs and PRQ. As discussed earlier, the portfolio of research methods used in this dissertation consisted primarily of the following four: a simulation modeling an MLR, an industry survey, and a qualitative case study.

3.2.1 Simulation Modeling

Computer simulation is a valuable technique for strategic and tactical decision-making while examining and analyzing complex and dynamic systems. A simulation model consists of rules that define how a system changes over time given its current state. Unlike analytical models, a simulation model is not solved but is run, and the changes in system states can be observed at any point in time. Simulation is not a decision-making tool but a decision support tool, allowing better-informed decisions to be made. Due to the complexity of the real world, a simulation model can only approximate the system. The essence of the art of simulation modeling is abstraction and simplification. Only those essential characteristics for the study and analysis of the target system should be included in the simulation model. It can be viewed as an artificial white room that allows one to gain insight and test new theories and practices without disrupting the daily routine of the focal organization (Siebers and Aickelin, 2008; Taylor, 2014).

For this study, the system under consideration consists of an SaaS provider and its customers. Simulation is defined as approximating purchasing decision-making processes by the customer as computer algorithms and then running these algorithms to generate a random sample of outcomes. Inferences can then be made about the system as a whole by analyzing the statistical properties of the sample of random observations under different scenarios associated with the SaaS provider's decision-making regarding the dynamic pricing approach used. The purpose of the simulation is to make predictions about a target system's performance and outcome.

3.2.2 MLR

MLR is gaining momentum in the academic literature, especially in critical areas for both scholars and practitioners when there is a need for interdisciplinary investigations and different perspectives. MLR combines state-of-the-art research and state-of-the-practice expertise when there is a clear gap between the academic literature and actual practice. While MLR methodology has been widely used in medicine and educational sciences, researchers in management and engineering recognized its value only less than a decade ago (Garousi, Felderer and Mäntylä, 2019). This MLR on SaaS pricing is the first of its kind, not just in the area of SaaS pricing but also in broader fields such as software product management and pricing management.

This MLR was performed as a part of this dissertation focused on SaaS and its pricing across various research domains and studies. The objective was to identify the state-of-the-art and the state-of-the-practice in SaaS pricing and provide a basis for further research in SaaS pricing. The scope of the study was not limited to a systematic review of academic publications (white literature [WL]). Instead, the body of literature also incorporated an extensive body of grey literature (GL) in the analysis. Following Lawrence et al. (2014), the study refers to publicly available knowledge artifacts in both digital and printed formats that can also be produced outside academic publication channels. The GL publications considered for this research include, but are not limited to, discussion and white papers, blog posts, reports, web pages, and magazine articles. The WL includes publications in academic venues that are prepared through a formal peer-review process. These include scientific journal articles, conference proceedings, working paper series, and monographs.

3.2.3 Industry Survey

An industry survey is one of the most widely used quantitative approaches in economics and management aimed to produce quantitative descriptions of some aspects of the study population. Information is generally collected about only a fraction of the study population, called a sample, in a way that allows a generalization of the findings to the whole population. Most often, surveys assume collecting data through questionnaires distributed among a randomly selected sample of the population (Pinsonneault and Kraemer, 1993; Gable, 1994).

However, in the case of the current dissertation, questionnaires were not used, and all the required information was collected by observing publicly available pricing information on SaaS solutions. The sample of SaaS companies was defined using the following three major databases of SaaS companies: Golden Research Engine,¹ GetLatka,² and SaaS Mag.³

¹ <https://golden.com/list-of-software-as-a-service-companies/>

² <https://getlatka.com>

³ <https://www.saasmag.com/saas-1000-2020/>

The analytical techniques used in exploratory industry survey analysis include descriptive statistics, correlation analysis, and factor and cluster analysis. Within the study included in the dissertation portfolio, the focus was on frequency analysis and synthesizing the numerical results with existing theories.

3.2.4 Multiple Case Study

A multiple case study is an important research method for obtaining qualitative empirical results in the industry. The handbook for case study research defines a case study as “an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context” (Yin, 2009). A case study can be done either within single or multiple cases. Multiple case studies consider more than one observation for study; however, they do not bring research design into a more quantitative area. In contrast to quantitative empirical methods, a multiple case study does not assume working with the sample that represents a larger population. For multiple case study research non-random sampling determined by various theoretical reasons is quite typical (Eisenhardt, 1989). The main strengths and advantages of multiple case study research are the ability to perform within-case and cross-case analysis to build a theory upon them (Woodside and Wilson, 2003). First, each case is analyzed as a single case on its own with certain theoretical conclusions. Second, a systematic comparison in cross-case analysis reveals similarities and differences and advances theories by their further analysis.

For this dissertation research, a positivist holistic multiple case study design was employed – examining multiple cases within their contexts to learn more about specific units of analysis. The case sampling strategy was guided by the diverse case approach, with its primary objective to achieve maximum variance along the relevant dimensions (Seawright et al., 2014). Referring to the research questions, the goal was to identify SaaS pricing decision-making practices and processes as well as to understand the logic behind them. To achieve this purpose, both a within-case and a cross-case analyses were conducted with the analytical strategy of explanation-building, based on the detailed case description using triangulated data; in other words, the study can be classified as exploratory case research.

4 Publication Overview

This chapter provides an overview of the publications included in the dissertation portfolio by describing the research motivation and context, summarizing the research objectives and questions, and evaluating the research findings and contributions.

4.1 Publication Outline

The dissertation portfolio consists of four publications published between 2016 and 2021. During this period of five years, the focus of the dissertation changed several times, and a number of related publications were also produced within this period. Only publications of direct relevance to the topic of the dissertation that contribute to revealing the state of SaaS pricing were included in the dissertation portfolio. Table 2 summarizes the research methods and questions of the publications included in this portfolio.

Table 2. Association of research questions with publications and research methods

Publication	Title	Research Method	Research Questions
Publication I	A Dynamic Pricing Model for Software Products Incorporating Human Experiences	Simulation Modeling	Which dynamic pricing model is more beneficial for the software company depending on the strength of the network effect and the availability of software piracy?
Publication II	Bridging the State-of-the-Art and the State-of-the-Practice of SaaS Pricing: A Multivocal Literature Review	MLR	<ul style="list-style-type: none"> • What is the current status of academic research and practical expertise in SaaS pricing? • How is SaaS pricing defined and disseminated by scholars and practitioners? • How can the research outcome and practical expertise support SaaS providers in pricing their products?
Publication III	How SaaS Companies Price Their Products: Insights from an Industry Study	Industry Survey	How do SaaS companies price their solutions?

Publication IV	SaaS Pricing Practices Typology: A Case Study	Multiple Case Study	What types of SaaS pricing practices can be identified in a real-life context?
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Publication I, published as a part of the Proceedings of the 7th International Conference on Software Business (ICSOB) in Lecture Notes in Business Information Processing (LNBIP) series, proposes an agent-based simulation model to assess the efficiency of using two dynamic pricing mechanisms – penetration pricing and skimming pricing. This study was performed at the very beginning of the dissertation research path in 2016. At that time, the focus on SaaS in terms of pricing in the software market was not yet in place. In many ways, the results of that study apply not only to SaaS solutions but also to software products in general. The publication poses the problem of designing a complex strategy for products and suggests how the proposed simulation model can be further extended and used in performing the complex analysis of such SaaS strategy. The publication also points out the theory-practice gap and the inconsistency in research and serves as a starting point for further research and a series of publication including the rest three publications included in the dissertation portfolio.

Publication II, published in 2021 in the Information and Software Technology journal, summarizes all the findings of a comprehensive study that reveals the state-of-the-art and the state-of-the-practice on SaaS pricing and explores the identified theory-practice gap and inconsistency in research on SaaS pricing. This study proposes a taxonomy of pricing-related concepts, classifying SaaS pricing aspects, the affecting factors, and the challenges facing SaaS providers. The preliminary results of that study were also presented at a workshop and a scientific conference. The performed MLR allowed the identification of several further research directions that can help to improve practices of pricing SaaS solutions. Two of these directions were followed and resulted in Publications III and IV.

Publication III, published in 2021 as a part of the Proceedings of the 11th ICSOB in LNBIP series, explores how SaaS providers package and price their products by reviewing the pricing information of 220 SaaS providers. It focuses on examining how industry practices correspond to the theory of pricing for products and services, including software and SaaS. The publication reports on the first results of the ongoing empirical research on SaaS pricing practices. More extensive data collected would have allowed a deeper quantitative analysis that might reveal more comprehensive findings.

Publication IV, published in 2021 as a part of the Proceedings of the 4th International Workshop on Software-Intensive Business (IWSiB) in LNBIP series, reveals the results of a multiple case study of 15 SaaS companies. As a result of an in-depth investigation of the companies, four major factors that affect pricing were identified, and four distinct types of SaaS pricing patterns were proposed. Similar to Publication III, this publication reports on the first steps of an ongoing study; further analysis, possibly, will allow an extension of the scope of this qualitative study of SaaS practices and deepen its findings.

4.2 Publication I

4.2.1 Motivation and Context

Dynamic pricing is a vital pricing mechanism available to software and SaaS companies while designing and implementing pricing. The two main approaches are penetration and skimming pricing. First, penetration pricing sees the use of low prices to maximize market penetration as its primary objective. This is especially important for software companies when entering the market if the alternative software already has a large installed base. Later on, it will be possible to raise prices. Penetration pricing is widely used in the software industry due to low variable costs and network effects. Second, companies utilizing skimming pricing set high starting prices and reduce them over time. The aim is to skim customers with a high WTP first and then move to consumers with a lower WTP and lower prices.

Scholars introduced several comparative statics models to assess the feasibility of these mechanisms. However, the issue of choosing the optimal dynamic pricing model has not been tackled in the academic literature, especially with the uncertainty in consumer valuation, network effect, and piracy. This might result from a lack of opportunity to carry out such analysis through traditional comparative statics microeconomic modeling. This motivated the development of a simulation-based dynamic model to evaluate the efficiency and effectiveness of using different dynamic pricing models.

4.2.2 Objective and Questions

The prime aim of the publication is to propose a dynamic model whose properties solve the managerial problem of choosing a dynamic pricing model for software products. The corresponding research question can be formulated as follows: *Which dynamic pricing model is more beneficial for the software company depending on the strength of the network effect and the availability of software piracy.*

4.2.3 Output and Contribution

The dynamic simulation model proposed in Publication I provides a chance to estimate the efficiency of different dynamic pricing methods in relation to various market and product factors. The model confirms the importance of each of the two factors considered – the network effect and the availability of piracy – and made it possible to construct an algorithm for choosing the optimal strategy. Figure 1 shows the distribution of the dynamic pricing strategies that the software company should follow depending on the strength of the network effect and costs of searching for a pirated version.

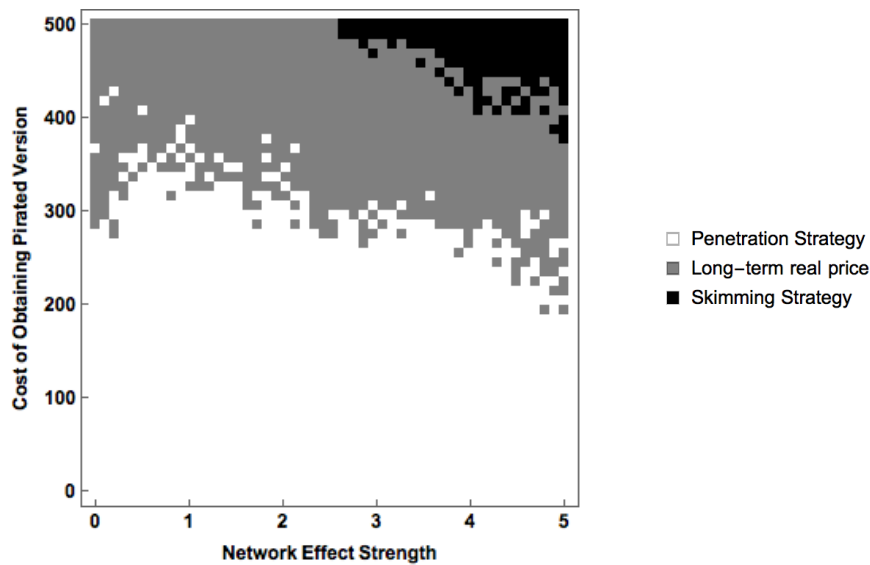


Figure 1. Distribution of pricing approaches in terms of their profitability for the company

The proposed approach and the simulation model based on it can be easily adapted for analyzing other managerial decisions concerning product and pricing strategy design. It allows the evaluation of different SaaS pricing mechanisms and the assessment of various affecting factors. Using the typology of SaaS pricing mechanisms and affecting factors revealed in Publications II to IV, a complex analysis of the SaaS pricing strategy can be carried out following the approach presented in this publication.

4.3 Publication II

4.3.1 Motivation and Context

A transition towards service licensing and delivering models for software products has already caused changes in engineering and business practices and processes in software companies. Pricing is an element of the product strategy that has been very strongly influenced by the transition towards the SaaS model in that pricing should be designed and implemented to reflect the need to stand out in the fast-growing service economy. However, a coherent SaaS pricing body of knowledge and verified solutions to assist SaaS providers while designing and implementing pricing are missing.

The inconsistency of SaaS pricing in the software industry is mirrored in the academic literature. The SaaS model has gained significant attention in software engineering and other IT research areas as SaaS is an essential component in the rapid development of service-oriented architecture and an essential component of cloud computing. Simultaneously, SaaS has also received interest in the product management and digital

economics domains due to its capability to significantly influence the business model and software market structure. However, the lack of a single “home” for studies on software and SaaS pricing in the academic community has resulted in isolated pricing-related studies with diverse and inconsistent approaches and recommendations.

The identified possible theory-practice gap and inconsistency of SaaS pricing studies inspired this study, which aimed to form a clear picture of the research and practice in SaaS pricing.

4.3.2 Objective and Questions

To bridge the state-of-the-art and the state-of-the-practice of SaaS pricing, an MLR approach was used for the study. The research protocol for the study is based on the guidelines for performing systematic MLRs and mapping studies. The formal research process is presented in Figure 2. The study focused on answering three broad research questions, with several clarifying sub-questions, as follows: (1) *What is the current status of academic research and practical expertise in SaaS pricing?* (2) *How is SaaS pricing defined and disseminated by scholars and practitioners?* and (3) *How can the research outcome and practical expertise support SaaS providers in pricing their products?*

To provide an answer to these research questions, a body of literature comprising 387 bibliography items was collected using a formal protocol. Of these, 57 were WL items, and 330 were GL items. A multistage content analysis process was implemented to classify the rich literature body across multiple dimensions with further mapping, synthesis, and reporting

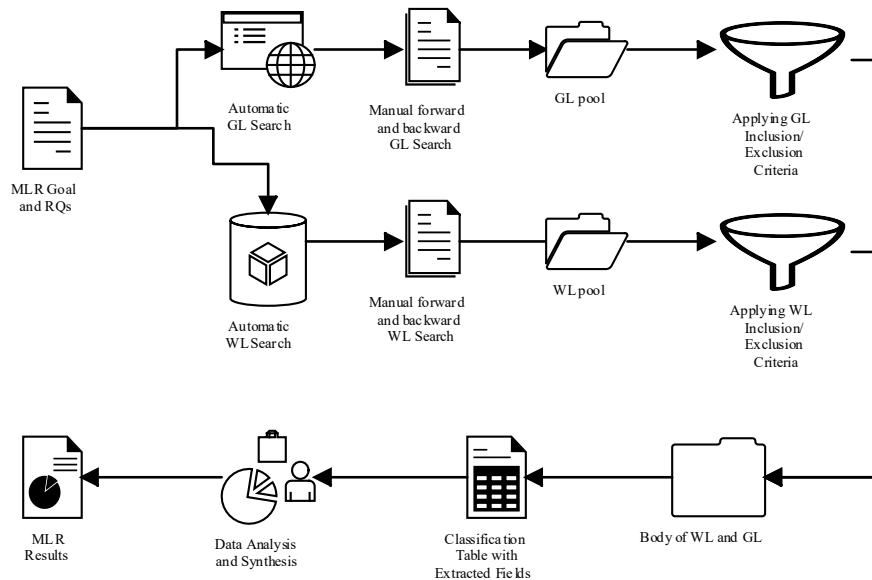


Figure 2. MLR research process

4.3.3 Output and Contribution

The MLR revealed that, since 2012, the number of academic publications published annually has been declining and that the total number of publications directly focused on SaaS pricing has been fewer than seven per year. While the number of WL studies is declining, the number of GL studies is increasing. The difference between the number of WL and GL publications and the growing number of GL publications could indicate that much research is still missing. The current research appears fragmented and separated from practice. The study revealed a wide variety of notions, terms, and concepts proposed in the publications. However, the presented frameworks and models designed to support decision-making in SaaS pricing seemed to lack coherency.

The analysis of the GL publications indicated how SaaS pricing is essential for the industry. These publications have delivered a broad range of recommendations and observations on SaaS pricing. While the GL publications were less systematic, they still covered a broader range of SaaS pricing aspects. By combining the WL and GL publications' findings, classifications of pricing aspects, objectives, affecting factors, and challenges facing SaaS providers have been proposed. Both academic research and industry observation showed that there is no unified approach to defining and implementing pricing. The findings of the conducted MLR have been summarized to emphasize the major research themes and practical challenges of SaaS pricing practices' transformation. The preliminary empirical conclusions (PECs) and recommendations of this study are summarized in Table 3.

Table 3. Summary of PECs and recommendations on SaaS pricing research

#	PEC	Recommendations
1	The number of WL publications per year is declining, indicating a decline of interest by scholars to pursue this topic. However, the number of GL publications is growing.	<ul style="list-style-type: none"> • Academic research on SaaS pricing can advance pricing practices and contribute to the further sustainable development of the rapidly growing SaaS market. • Scholars need to ensure that the research aim corresponds with pricing challenges facing SaaS companies
2	There is an imbalance between the amount of GL and WL, with a low number of publications by scholars and a high number of publications by practitioners.	<ul style="list-style-type: none"> • Special issues and conference tracks on SaaS pricing might provide incentives for scholars to perform such studies. • Scholars might consider non-systematic and often subjective recommendations and observations from the GL as a starting point for academic investigations.
3	There is an absence of any cross-references between the WL and GL and a scarcity in cross-references between research domains.	<ul style="list-style-type: none"> • Collaboration among scholars and experts in this area may promote further research and increase the value of the practical implications of their studies.

#	PEC	Recommendations
		<ul style="list-style-type: none"> The SaaS industry might benefit from scholars' proactiveness in sharing research findings in the SaaS pricing area with practitioners by being involved in preparing GL publications.
4	The portfolio of research methods employed in the academic studies presented in the WL is mostly limited to theoretical modeling and non-systematic reviews.	To advance the knowledge on SaaS pricing, a broader range of studies should be conducted.
5	Both the GL and WL lack quantitative studies and extensive surveys.	The range of studies on SaaS pricing might include large-scale quantitative studies based on extensive surveys and collect publicly available data and companies' datasets.
6	Scholars, unlike practitioners, tend to avoid a contextualization of the research, assuming a homogeneity of SaaS solutions, consumers, and markets.	Research can benefit from assessing the influence of different product characteristics and specific contexts on pricing.
7	Existing academic studies provide quite a narrow view of the objective of SaaS pricing. They do not disclose the role of pricing in the organizational context. Practitioners deliver a more comprehensive, but still disorganized, vision of pricing roles and objectives.	Exploring the role of SaaS pricing and its objectives is an essential step in further SaaS pricing research.
8	Research on SaaS pricing has mainly focused on general pricing issues and strategy design. There is little research on pricing tactics, organizational processes, and practices in SaaS pricing.	Scholars should conduct studies to explore SaaS pricing tactics, organizational processes, and practices. Existing generic studies on pricing tactics and processes could be reconsidered and replicated in the SaaS context.
9	Scholars and practitioners introduced several approaches aimed to structure and dissect SaaS pricing from several perspectives. However, the proposed approaches are inconsistent with each other.	Various SaaS pricing typologies and approaches need to be systemized to deliver a coherent meta-model of SaaS pricing.

#	PEC	Recommendations
10	Scholars and practitioners seem to lack a coherent vocabulary of terms associated with SaaS pricing.	Pricing strategy research and practice will benefit from a unified system of concepts and terminology that compares different pricing practices across the SaaS market.
11	Little is known about the challenges facing SaaS companies while designing and implementing SaaS pricing.	Scholars should reveal SaaS pricing challenges and address them in their studies
12	A wide range of SaaS pricing factors has been mentioned. However, not all factors have received much attention in the academic literature, and an assessment of these factors' influence on pricing has never been systematically conducted.	Scholars should conduct studies to assess the influence of various factors on SaaS pricing quantitatively and qualitatively.
13	No single SaaS pricing decision-making framework can address the whole SaaS pricing problem due to the complexity of factors and their interrelations.	A systematization of different decision-support SaaS pricing frameworks is needed to assist practitioners.
14	No information on the actual usage of the proposed decision-support frameworks by SaaS providers has been disclosed.	Scholars need to ensure that the proposed frameworks can be taken into account and employed by companies and implemented in a real-world environment.

4.4 Publication III

4.4.1 Motivation and Context

Pricing is one of the business and product strategy elements crucial for achieving both financial performance and competitive advantage. The transition towards the SaaS model has unlocked new opportunities for pricing software products. Conflicting recommendations from existing studies and industry experts make it challenging for SaaS providers to design and implement the pricing of their services. SaaS providers have come a long way in adapting their pricing practices to the new paradigm that assumes the offering of a service instead of selling software as a product.

At the same time, the performed MLR study (Publication II) indicates that just a few studies aimed to assess practices of SaaS pricing and that further research is needed to understand the industrial status quo. Publication III reports on the results of the study that

explores how SaaS providers package and price their products by reviewing the pricing information of 220 SaaS providers.

4.4.2 Objective and Questions

The prime objective of the study is to empirically evaluate contemporary SaaS pricing practices using data on 220 randomly selected SaaS companies. The corresponding RQ that drives the study is as follows: *How do SaaS companies price their solutions?* The collected data cover nine pricing aspects grouped into the following three levels: strategic, tactical, and operational. Working with open data provided by SaaS companies on their pricing pages allows an assessment of aspects of SaaS pricing that have never been raised in the academic literature before.

4.4.3 Output and Contribution

The study reveals that SaaS companies are relatively heterogeneous in the way they price their products. SaaS providers have come a long way in adapting their pricing practices to the new paradigm that assumes offering a service instead of selling software as a product. There is a shared vision of how SaaS solutions should be priced, and it is shared by most SaaS providers, which, however, does not lead to identical pricing practices. The study mainly concentrated on versioning design, selecting value metrics, using the freemium model, and offering users free-trial options.

Figure 3 reveals that most SaaS providers offer three or four versions. This number includes free versions offered by some SaaS providers but does not include the opportunity to directly contact SaaS providers if the available offerings do not match customer requirements. Mature and large companies tend to offer a high number of versions, as do companies that aim at both B2B and B2C markets. Additionally, for more than half of SaaS providers, the average price increase ratio between adjacent non-free versions is from 2 to 3 (Figure 3, right). The empirical analysis reveals that the vast majority of SaaS providers use either user-based or function-based value metrics. The complete picture of the distribution of SaaS solutions in the sample regarding the number of offerings is presented in Figure 4.

A comparison of the results of the study with the results of the limited number of existing similar empirical studies, all of which were published more than five years ago, confirms that SaaS pricing is becoming increasingly more sophisticated. Most SaaS providers are offering multiple versions, designed and priced based on consumer value metrics.

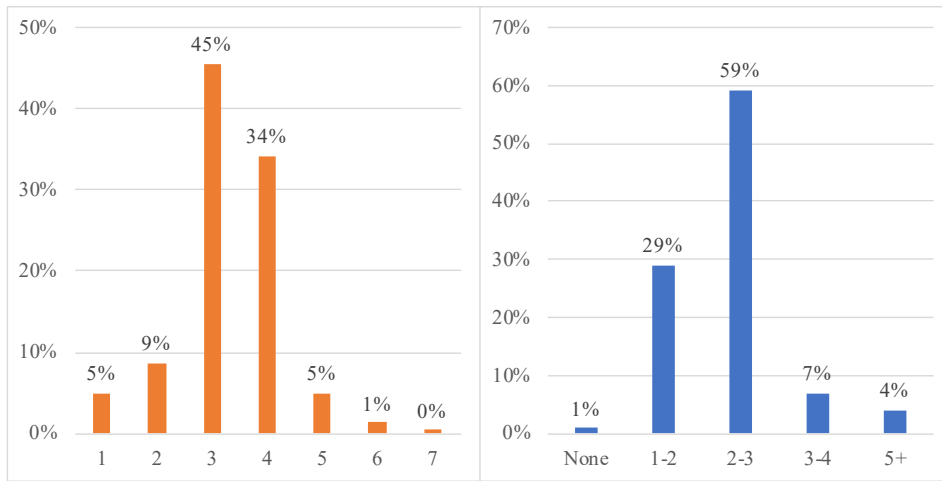


Figure 3. Distribution of SaaS solutions based on the number of offerings (left) and average price increase ratio between versions (right)

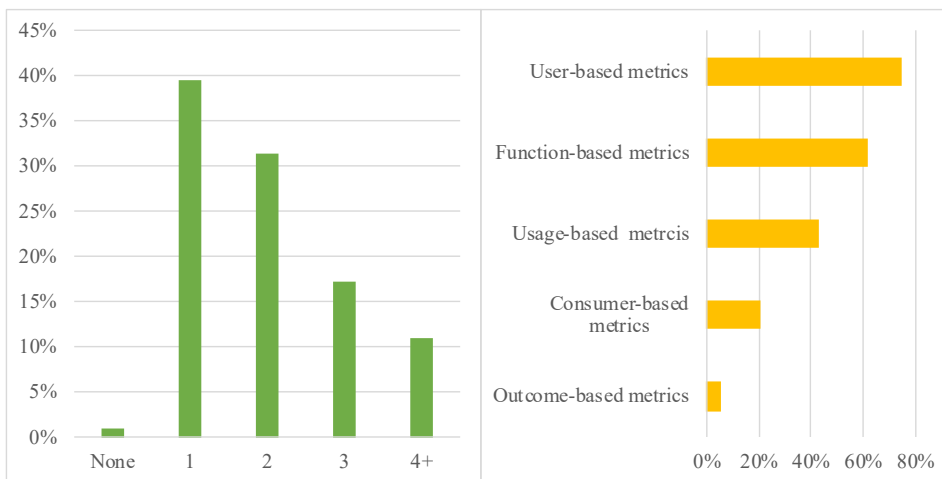


Figure 4. Distribution of SaaS solutions based on the number of value metrics used (left) and frequency of using different types of metrics (right)

4.5 Publication IV

4.5.1 Motivation and Context

Pricing serves as an essential bridge between different business functions (e.g., product planning and development, revenue and cost management, and customer acquisition and

retention) and business units (e.g., R&D, product management, sales, and marketing). Recent studies and reviews indicate progress and sophistication in SaaS pricing and growing attention from practitioners. Multiple challenges for companies can still be identified that require support from the research community.

Overwhelming and complex pricing-related processes and structures, the unclear segregation of responsibilities for pricing between the managers involved, premature decision-making practices, and constantly changing objectives are often prime challenges. Efficient pricing requires developing sophisticated multi-layered structures with many different mechanisms and options considering the trade-offs, objectives, and outcomes that pricing must meet. Informed SaaS pricing decision-making requires the involvement of different stakeholders and the consideration of many factors, including market characteristics, product and technology specifications, customers, and customer needs and expectations. Considering these factors requires collecting a vast amount of data and advanced analysis – tasks that are not trivial.

4.5.2 Objective and Questions

The study aims to identify and evaluate patterns in SaaS pricing and the major factors that affect it and propose a typology of SaaS pricing practices. The study presented in Publication IV complements other publications on the inquiry into how SaaS companies design and deploy their pricing practices and processes.

The following research question drove the study: *What types of SaaS pricing practices can be identified in a real-life context?* A multiple case study research method to compare existing SaaS pricing practices and processes was adopted to address this question. The case sampling strategy was guided by the diverse case approach, with its primary objective to achieve variance along the relevant dimensions.

4.5.3 Output and Contribution

The research findings suggest that the major factors of pricing in SaaS companies are the following: the targeted types of customers and market segments, the perceived value and WTP for the SaaS solution, the complexity of the SaaS solution and its adoption by customers, and the level of nicheness of the SaaS solution. While the typology was based on an assessment of SaaS pricing practices, it can also be interpreted from the perspective of SaaS companies' business models. The analysis of these four factors led to the developed typology of four generic SaaS pricing approaches, labeled as *mass-market SaaS pricing*, *generalist SaaS pricing*, *specialist SaaS pricing*, and *high-rise SaaS pricing*. These four pricing approaches are summarized in Table 4.

Table 4. Typology of SaaS companies based on pricing practices

	Mass-market SaaS pricing	Generalist SaaS pricing	Specialist SaaS pricing	High-rise SaaS pricing
F1: Targeted types of customers and market segments	B2C and B2B	B2B	B2B	Large B2B, B2G
F2: Perceived value and WTP	Low value and WTP	Low or moderate value and WTP	Moderate or high value and WTP	High value and WTP
F3: The complexity of SaaS purchase and usage	Self-service	Self-service	Moderate human involvement	High human involvement
F4: Level of SaaS niceness	Mass market	Mass market	Niche market	Niche Market

5 Discussion

This chapter summarizes and reflects on the dissertation findings, highlights implications and recommendations to both academic scholars and industry practitioners, and proposes further research directions.

5.1 Research Contributions

Motivated by the lack of consistency in academic research on SaaS pricing and the theory-practice gap, this dissertation posed the following PRQ:

PRQ: How do software companies establish and implement the pricing of their SaaS solutions, and how can the associated processes and practices be improved?

The PRQ was further divided into the following three research questions:

- RQ1: What is the status of the academic research and practical expertise in SaaS pricing?
- RQ2: What types of SaaS pricing practices can be identified in a real-life context?
- RQ3: How simulation modelling can support SaaS providers in pricing their products?

To answer these questions, a series of studies, documented in Publications I–IV, were conducted employing various research methods and addressing the problem of designing and implementing SaaS pricing from different perspectives. Together, these studies reveal the nature of SaaS pricing and establish the recommendations on how pricing can be improved.

The current research on SaaS appears fragmented and separated from practice. A wide variety of notions, terms, and concepts proposed in publications were identified within the dissertation. However, the presented frameworks and models designed to support decision-making in SaaS pricing seemed to lack coherency. Almost no evidence was found that practitioners actually use research findings and researchers seldom claimed how their results were directly used in the real world. The analysis of the GL publications indicated how SaaS pricing is essential for the industry. These publications have delivered a broad range of recommendations and observations on SaaS pricing. While the GL publications were less systematic, they still covered a wider range of SaaS pricing aspects. Unlike practitioners, scholars can offer more systematic and rigorously developed solutions and recommendations to support SaaS companies in their pricing. By combining the findings of the WL and GL publications, SaaS pricing aspects, objectives, affecting factors, and the challenges facing SaaS providers were classified.

MLR was followed by an industry survey and case study research exploring SaaS pricing practices and processes in real companies. The industry survey revealed that SaaS companies are relatively heterogeneous in the way they price their products. SaaS

providers have come a long way in adapting their pricing practices to the new paradigm that assumes offering a service instead of selling software as a product. A shared vision of how SaaS solutions should be priced exists and is shared by most SaaS providers, which, however, does not lead to identical pricing practices. A comparison to the limited number of existing empirical studies, all published more than five years ago, confirms that SaaS pricing is becoming increasingly more sophisticated. Most SaaS providers are offering multiple versions designed and priced based on consumer value metrics. With all its promising benefits, the freemium model did not become widespread; most companies that employ this model operate on B2B and B2C markets and offer generic solutions for a broad audience.

The performed case study allowed the development of a taxonomy of pricing practices that can serve as a foundation for designing and establishing pricing practices in SaaS companies. The research findings suggest that the significant pricing factors in SaaS companies are the following: the types of customers and market segments targeted, the perceived value and WTP for the SaaS solution, the complexity of the SaaS solution and its adoption by customers, and the level of nicheness of the SaaS solution. While the typology was based on an assessment of SaaS pricing practices, it can also be interpreted from the perspective of SaaS companies' business models.

The proposed simulation model evaluates the efficiency and effectiveness of using two main dynamic pricing approaches – penetration pricing and skimming pricing. It appeared that both might be beneficial for software companies when pricing their SaaS solutions depending on two factors – network effect strength and the availability of pirated versions. The analytical approach the simulation model is grounded in can be further adapted for analyzing other SaaS pricing mechanisms depending on various factors related to the external environment, the company, or the SaaS product itself.

5.2 Implications for Research and Practice

The theoretical implications of the dissertation include the proposed analytical simulation model, proposed taxonomies and classifications related to SaaS pricing, and identified gaps in the current body of research on SaaS pricing. The demonstrated modeling approach can be further used to analyze the efficiency and feasibility of other pricing mechanisms depending on internal and external factors. What kind of mechanisms should be investigated and what factors should be considered were revealed in the proposed typologies and classifiers of SaaS practices, aspects, and affecting factors.

The dissertation pays special attention to further research opportunities by recognizing and analyzing gaps in the current research on SaaS pricing. These identified gaps are mostly related to the inconsistency among the different perspectives, the limited scope of the methodologies employed, or the lack of clarity on the real obstacles of designing and implementing pricing in SaaS companies. The analysis of the WL and GL publications allowed a research agenda to be proposed.

This dissertation also has practical implications for industry professionals, including consultants and managers in software companies responsible for pricing. The proposed typology of SaaS pricing practices may help companies to profile themselves in the space of SaaS solutions. This profiling supplements with the proposed classifications of aspects, affecting factors, structures, and frameworks enables companies to improve their pricing processes and practices.

5.3 Proposals for Further Research

The current dissertation revealed a clear picture of the current state of SaaS pricing. As comprehensive and complete research in its essence, the dissertation unlocks and highlights many opportunities for further research in the field of pricing in the context of SaaS and software solutions in general. An extensive list of further studies required to close the theory-practice gap and bridge different research perspectives on SaaS pricing was proposed in Publication II. Below, three particularly promising research opportunities that would contribute to understanding SaaS pricing and offer SaaS pricing decision-support solutions are discussed in detail. All three form a logical continuation of the studies included in the current dissertation.

- The findings of the industry survey presented in Publication III provide a valuable overview of SaaS pricing practices. However, the analysis was limited to a descriptive analysis and matching them with current pricing theories. Furthermore, the scope of the study did not cover the entire population of SaaS companies. Additionally, publicly available data can be supplemented with data from more extensive surveys. A larger-scale study based on a more considerable amount of data and more sophisticated methods of analysis would allow a comparison of SaaS pricing practices in different contexts and reveal a more comprehensive typology of SaaS pricing practices and processes.
- The exploratory case study presented in Publication IV was based on static information obtained from 15 SaaS companies through semi-structured interviews. Conducting longitudinal case studies with data sources beyond interviews is essential for evaluating SaaS pricing processes and assessing their efficiency and might lead to a more extensive and comprehensive taxonomy of SaaS pricing aspects, practices, and processes.
- Finally, further research might employ design science and action research to deliver decision-support frameworks, algorithms, and tools. In many cases, effective pricing is impossible without effective economic analysis. Such an analysis can and should be based on existing economic works, but, to be helpful to a wide range of companies, these models must be turned into straightforward and easy-to-use algorithms and decision-support tools.

6 Conclusion

The growth of the SaaS market and SaaS penetration in the IT and business landscapes shows no signs of slowing down. This dissertation, to a large extent, focuses on the exploratory investigation of SaaS pricing. It aimed to explore how software companies price their SaaS solutions and assess how associated practices and processes can be improved. A series of studies employing a mixture of qualitative and quantitative methods was performed to reach the stated aim.

In particular, an MLR of existing publications was conducted to form a clear picture of the current state of SaaS pricing research and practice. The review created a taxonomy of pricing-related concepts, classifying SaaS pricing aspects and the factors and challenges affecting SaaS providers. Next, a survey of pricing employed in existing SaaS companies was conducted. The market overview was based on the detailed analysis of 220 pricing pages of SaaS companies available for analysis. In continuation, a case study of 15 SaaS companies was performed to explore decision processes and practices related to SaaS pricing in software companies.

Along with that, an integrated simulation model of SaaS pricing as an example of a solution that might be used in SaaS pricing decision-making is proposed to illustrate trade-offs between pricing mechanisms and SaaS characteristics. The simulation model estimated the efficiency of using dynamic pricing mechanisms to be made. Although the model allows obtaining a better understanding of the usage of different dynamic pricing mechanisms, it also shows an approach for analyzing a comprehensive pricing strategy as a portfolio of multiple pricing mechanisms. Above all, the observed growth of interest in the SaaS model in the industry is at odds with the interest of researchers in the business aspects of SaaS, at least when it comes to pricing.

This dissertation also intends to reverse the current situation by exploring what is missing in the current research on SaaS pricing and what research is needed for practitioners. A number of possible paths for further investigation into issues related to SaaS pricing by broadening the scope of the research methods, extending the range of data used for the analysis, and deepening the level of the analysis are outlined in the dissertation.

The dissertation ultimately aims to empower and guide software companies in evolving their SaaS pricing practices. In the long run, this should lead to the greater sustainability of the SaaS industry as superior SaaS solutions will not face market failure due to inappropriate pricing leading to poor customer acquisition, monetization, and retention.

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Publication I

Saltan, A., Nikula, U., Seffah, A., and Yurkov, A.
**A Dynamic Pricing Model for Software Products
Incorporating Human Experiences**

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A Dynamic Pricing Model for Software Products Incorporating Human Experiences

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Abstract. At the age of software as a service (SaaS) and cloud computing as compared to what is used to be earlier, designing product strategies is a challenging concern for software product management researchers. Comparative statics models are considered to identify software market characteristics while assessing the managerial decisions during the software product strategy design. However, their applicability in dynamic market analysis is rather limited. Important concerns in dynamic market such as dynamic pricing cannot be fully estimated. This motivated the development of a simulation-based dynamic model to evaluate the efficiency and effectiveness of using different pricing models. The proposed (simulation) approach given in details in this paper can be used in conducting complex analysis of software product strategy that involves consideration of product strategy as a portfolio of interrelated solutions rather than a set of independent managerial decisions.

Keywords: Software product strategy · Software market · Decision making · Pricing model · Simulation model

1 Introduction

The ever changing software markets make it difficult for software development companies, big and small ones, to improve and package their products as well as to customize it to the diverse markets and consumer needs. They also have to look for other discontinuous innovation or disruptive technology that will revolutionize their industry or require heavy reengineering and re-packing of their software products. Furthermore, the rapid change that characterizes software industry today results in high instability and uncertainty, which may make product strategy development meaningless. In reality, the inverse proves to be true, and in this case product strategy becomes even more crucial than in other industries due to the nature of high-tech markets [5].

Two decades ago, the software companies' product strategies were slightly different from the strategies of any other goods. Software products were sold as physical

products on a CD or a floppy disc. Most often, they are packaged in two or three versions (e.g. professional/domestic, beginner/advanced, etc.). Nowadays, software as a service, mobile, web-service and the future services for the Internet of things are making software very different from other goods. We see them as indestructibility, transmutability, and reproducibility [9]. The evolution of the Internet has challenged the company to reconstruct their product strategy.

From scientific point of view, product strategy lies in the intersection of product design and development, marketing and sales, strategy and business. There is no universal product strategy, neither a unifying theory is. Each company has its own strategy that takes into account the software product specifications, the market segment characteristics as well as the consumers' experiences, needs and expectations. Various models have tried to address these notions concerning product strategy.

The traditional comparative statics models were introduced first to identify software market characteristics and qualitatively assess factors determining its development. Software market and software product characteristics being identified offer unprecedented opportunities to companies. However, the application scope of these models as a tool for qualitative and dynamic market analysis are very limited. The development of simulation-based models to design a product strategy based on the dynamic presentation of software users' experiences seems to be potentially an efficient approach. The mentioned task has both theoretical and practical effect on development of informational economy since business models and product strategies of today's market participants – the software companies – up to now are being developed intuitively, and later being corrected according to cut-and-try method. With this economic viability and effectiveness of business models can be tested by their approbation at the real market, while companies have no instruments for their justification in advance.

In this paper, we investigate one specific model for evaluating the potential of the dynamic pricing strategy. The main objective of this paper is not only to develop a practical model that industry can use. This is a long-term objective that requires years of research. More precisely the key objective is to develop a ground for studying market analysis at the research level. Still, possibility of carrying out complex analysis of software product strategy based on the proposed model is discussed.

2 Background and Works Related

Our research is based on the previous investigations on software economics in general and pricing aspects of product strategy in particular. Studying the existing academic papers and analytical research reveals the following software market determinants describing the fundamental characteristics of software as digital goods:

1. The software markets are determined by network effect. Direct network effect or the so-called Demand Side Economies of Scale results in the fact that potential consumers' value and willingness to buy software correlates with total amount of users existing. Indirect network effect or the so-called Supply Side Economies of Scale create the situation in which the increase in sales of the original software results in rising sales of complementary goods, which in turn increases the value of the original product for users [10, 14].

2. Economies of scale and network effect cause non-stop price pressure for the companies operating on software markets and make for the establishment of monopolies and oligopolies on these markets [13].
3. In addition to the network effect, the important property of software being a digital good is the possibility of being copied easily without significant loss in quality. This results in unauthorized use or piracy. The practice shows that piracy being on high level on a specific regional market prevents companies from reducing it by their own. This makes companies design their product strategy taking piracy as one of market characteristics and trying to minimize their financial losses or even improving their non-financial indicators [3, 4, 12].
4. Extremely low costs of reproducing software results in the situation in which companies have a structure of expenses with high fixed expenses for software development and incomparably small variable expenses [1].

Under the name of a software company, we mean companies dealing with R&D, distribution and maintenance of general software products aimed at the wide range of consumers. Software consumers are natural persons who buy produced software products for their own purposes.

The above mentioned software products and software markets characteristics result in an extremely diverse list of options available for designing software product strategy. While offering value to the consumers at the right price is the prime aim of software companies, versioning and pricing plays a key role in most software companies' product strategies [10]. Monopolistic competition market and costs structure let software companies to establish any pricing policy they need. Its inadequacy, though, will soon result in serious financial problems.

Recently, several studies [6, 8, 9] have examined the structure of the pricing policy. Despite different approaches all the above mentioned studies identified dynamic pricing as one of the key options in designing the pricing strategy supported by price bundling and price discrimination. As far as we know, the problem of choosing the optimal dynamic pricing model has not been tackled in the literature, especially with the uncertainty in consumer valuation, network effect, and piracy. We believe it to be the result of lack of opportunity to carry out such analysis by means of microeconomic modeling. At the same time, the dynamic modification of existing models gives us a chance to estimate efficiency of different methods of dynamic pricing in relation to various market factors.

Traditionally, according to [6, 11] the dynamic pricing has been based on the following four policies:

- **Penetration pricing.** Penetration strategy sees using of low prices in order to maximize market penetration as its main objective. This is especially important for software companies when entering the market if alternative software already have a large installed base. Later on it will be possible to rise prices. This strategy is widely used in the software industry due to low variable costs and network effect.
- **Skimming pricing.** Companies utilizing skimming strategy set rather high starting prices to reduce them in the course of time. The aim is to skim consumers with high willingness to pay first and then move to consumers with lower willingness to pay and offer them lower prices.

- **Long-term real price.** The long-term real price strategy involves keeping the product launch level price within the sustained period of time. So prices are not adjusted as a predetermined part of the strategy.
- **Free-pricing.** In case of the follow-the-free strategy, consumers receive a product for free. The software company's objective is to create a lock-in effect on the consumers' side in order to generate revenues later on by means of complementary products or premium versions.

Harmon et al. [6] indicate some possibilities for hybrid dynamic pricing associated with bundling or versioning, but these options are out of scope of this study.

3 The Small Picture: Dynamic Pricing Model

Figure 1 demonstrates the proposed model for dynamic pricing. It differs substantially from the microeconomic models that are most cited and used. We propose a dynamic model that poses the properties allowing to solve the managerial problem of choosing one out of three types of dynamic pricing: Penetration, Skimming or Long-term real price. We've excluded Free-pricing because the assumptions behind this model do not allow us to demonstrate possible attractiveness of this strategy for a particular type of software products.

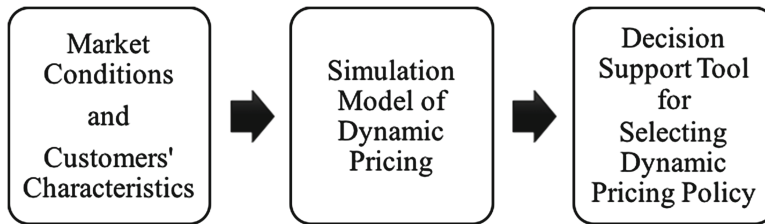


Fig. 1. Approach for developing Dynamic Pricing Model

3.1 Basic Assumptions on Software Market Structure

The software market structure model is based on the following assumptions:

1. In this model we consider software market that consist of a certain number of potential users for newly developed software product. Information about the new product spreads according to the theory of diffusion and can be expressed by the following equation:

$$m_i = m_{i-1} + (a + bm_{i-1})(m_G - m_{i-1}), \quad (1)$$

where m_G – total number of potential consumers on the software market, m_i – number of potential consumers who are informed about the new product by time

period t_i , $i = 0, \dots, T$, T – quantity of time periods when software will be available for the consumers, a , b – parameters reflecting the speed of information spreading.

2. In addition to the original version provided by a software company, pirated version is also available for consumers on the market. Consumers do not pay for pirated version, but they bear costs of finding appropriate ones. These costs can be estimated in monetary terms. Suppose that costs expected for obtaining pirated version are the same for all consumers and equal to c .
3. Every time a consumer uses the product he/she gets some value out of it. This short-term value can be estimated in monetary terms by a consumer and includes two components both internal and network ones. The internal component is defined as the value resulting from using the software in the situation when no one but the user uses it. The network component is known as the benefit depending on the total number of users of this software and is the same for all its users.
4. Let us assume that there is a complete awareness of all potential users that concerns all major market parameters. Besides this, every consumer can calculate long-term value over original and pirated versions and makes rational surplus-maximizing decision on the necessity of using either the original or the pirated one. Consumer's rationality and awareness are traditional simplifications for economic models taking into account consumers behavior. Consumers' bounded rationality can still be considered later and requires preliminary investigations connected with studying the degree of users' rationality in decision-making on software using which have not been carried out.
5. Both software development and sales are considered by the company as investment project. We shall assume that the software development costs are fixed and do not depend on demand, while variable costs per software copy are equal to zero. The software company needs to determine dynamic pricing strategy for its original product that will maximize discounted revenue from selling the original version within the given time horizon.

All the suggested market assumptions are traditional for economic models used for both modelling and investigating markets for durable goods. Taking into account the network effect as well as the availability of pirated versions and the opportunity of different pricing policies is only possible through using simulation modelling.

3.2 Modelling Software Consumer Behavior

The market consists of surplus-maximizing potential consumers. Consumers are heterogeneous in their valuation of the above mentioned software product. Let's index every individual consumer by k . The values for original and pirated versions for the consumer k within the time period t_i will be denoted by $V_{k,i}^O$ and $V_{k,i}^P$ respectively. We define the log-normal distribution for the initial internal value ($i = 0$) of both product versions for all consumers. We simulate internal consumer value for both original and pirate versions within time period t_i as the sum of both internal value within the previous period of time and random variable η_O and η_P respectively. We believe these random variable η_O and η_P to be independent and distributed identically according to

normal distribution with zero mean and variance σ for original version and mean $-\mu$ and variance σ for the pirated. The assumption of diminishing utility of pirated version takes place because of the fact that pirated product user does not receive software updating service from the company. He also faces the risk that the program may be suspended or the initial installation will lead to its being infected by a computer virus.

The network component of the software product value is defined as a non-decreasing function of the total number of users. To make it simple let's consider the linear type of this function: $f(n_i) = e \cdot n_i$, where parameter e – the power of network effect.

The consumer calculates the expected total value of using software for the original ($E[V_k^O]$) and pirated ($E[V_k^P]$) versions by integrating over all the paths of valuations and makes the decision either on buying, or using pirated version, or rejecting to use the product according to rational and surplus-maximizing rules presented in Table 1.

Table 1. Decision-making rules

DECISION	RULE
BUY ORIGINAL VERSION	$\begin{cases} E[V_k^O] - p_i + f(n_i) \geq 0 \\ E[V_k^O] - p_i \geq E[V_k^P] - c \end{cases}$
USE PIRATED VERSION	$\begin{cases} E[V_k^P] - c + f(n_i) \geq 0 \\ E[V_k^O] - p_i < E[V_k^P] - c \end{cases}$
DO NOT USE	$\begin{cases} E[V_k^O] - p_i + f(n_i) < 0 \\ E[V_k^P] - c + f(n_i) < 0 \end{cases}$

3.3 Optimization Problem for Software Company

As is was discussed earlier, all market parameters and distribution of valuations across consumers are well known by the software company. Still, the company knows nothing about its particular consumer. The company should define dynamic pricing policy by selecting one of these options:

- Using long-term real pricing;
- Using penetration pricing;
- Using skimming pricing.

According to our pricing model, we believe that the company denotes a “fair” price for its product with p . This price is determined by two factors: current prices for similar products as well as consumers’ willingness to pay for this product. Using long-term real price strategy requires the company’s selling software at the given price over the given time horizon. Using penetration pricing presupposes that the company should initially offer its consumers the 50 % discount and then sequentially raises the price and in the last period it sells software with the 50 % premium to the price considered “fair”. The skimming pricing is completely opposite to the penetration pricing: the company consistently drops the price over the given time horizon from a 50 % premium to a 50 % discount.

The company is trying to maximize discounted revenue over the given time horizon from selling the original version in respect to demand restrictions associated with their consumer's rational behavior and availability of pirated version on the market:

$$\pi = \sum_{i=0}^T \frac{p_i d_i(p_i)}{(1+r)^i} \rightarrow \max, \quad (2)$$

$$\left\{ \begin{array}{l} d_i(p_i) = \left| \left\{ k \in M_i \setminus N_i : \left\{ \begin{array}{l} E[V_k^O] - p_i + f\left(\sum_{j=0}^{i-1} (d_j + q_j)\right) \geq 0 \\ E[V_k^O] - p_i \geq E[V_k^P] - c \end{array} \right\} \right\} \right|, \\ q_i(p_i) = \left| \left\{ k \in M_i \setminus N_i : \left\{ \begin{array}{l} E[V_k^P] - c + f\left(\sum_{j=0}^{i-1} (d_j + q_j)\right) \geq 0 \\ E[V_k^O] - p_i < E[V_k^P] - c \end{array} \right\} \right\} \right|. \end{array} \right.$$

To solve this maximization problem, methods of iteration searching, approximation on a constant-pitch grid and simulation modeling are used.

3.4 Results

Figure 2 represents distribution of dynamic pricing strategies that the software company should follow depending on the strength of the network effect and expenses for searching a pirated version. As Fig. 2 shows, dynamic pricing can result in increase of revenue of software company.

The economic explanation of result given above is as follows: when the costs of obtaining pirated version are low, the only option for the company is to decrease the initial price to rise it only later when the network effect increases the consumers' value

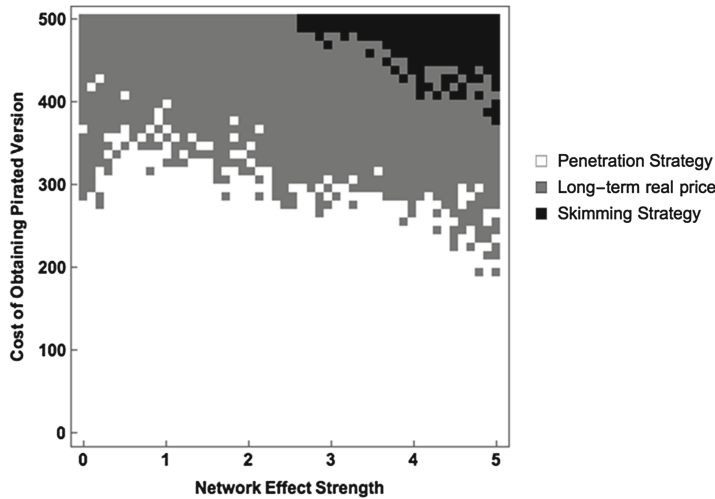


Fig. 2. Distribution of dynamic pricing strategies

and their willingness to pay. This is exactly what penetration strategy means, so with costs being low companies should use penetration pricing.

In case of high searching costs for pirated versions the company may avoid focusing on fighting the piracy and it may set a “fair” price from the very beginning. This will bring to the increased revenue due to the time value of money. In addition, with the network effect being strong, the company may even try to use skimming strategy: we can always find people with high internal value. Even if the number of such people is small, they will create network effect and attract other people to follow their way.

4 The Big Picture: Software Product Strategy Design

Software pricing is a key issue that not only influences the commercial success of any software product, but it is also an important activity in the software product strategy design. Further we shall highlight and discuss the importance of the proposed model as part of the big picture of the software product strategy design.

The issue of designing software product strategy is a matter of detailed study in the sphere of information technologies. This resulted in the emergence of a whole stream of academic research dealing with analyzing the software product strategy.

The proposed approach and the simulation model based on it can be easily adapted to analyzing other managerial decisions with regard to product strategy design. However, the product strategy mentioned is an aggregate portfolio of managerial decisions similar to the discussed in the previous sections. The analysis of this product strategy requires the portfolio approach.

There is no unified and conventional approach to determining the product strategy. Still, a large variety of product strategy definitions and concepts can be found in the economic literature. The restrained point of view suggests to focus exclusively on marketing issues while the wider one doesn't make distinction between product and business strategies. The former approach is more typical for past year papers, when it was believed that sales and marketing could be separated from development and other business issues. The latter approach on software product strategy can be found in papers on start-ups and entrepreneurship. In case of start-ups it can be difficult to distinguish between product and business strategies mainly since the same people are in charge of making all managerial decisions for different areas of business process.

Nowadays product strategy is believed to lie at the intersection of three business functions: sales and marketing, strategy and finances, development and design. Buxmann [2] suggests making a distinction between product design strategy, communication strategy, distribution strategy, and pricing strategy. Buxmann separates the product strategy component associated with software development. In line with the proposed integration idea, though, it seems logical to rewrite the offered software product strategy as follows: Communication and Promotion, Sales and Distribution, Upgrade and Support, Versioning and Pricing.

Pricing decision is one of the most crucial decisions which a company can make when planning the launch of any new software product. Comprehensive taxonomy of pricing models for durable goods has been proposed by Iveroth [7] who also defines

pricing models as systems of price-related characteristics of the agreement between buyer and seller. Price models are described with the help of 5 dimensions listed without priority of anyone: Scope, Base, Influence, Formula, Temporal Rights. The framework is called the SBIFT model that is the abbreviation of the dimensions mentioned above. Laatikainen et al. [8] evaluated and adapted SBIFT model to be applied in the sphere of cloud services. As a result, they suggested a 7-dimensional pricing framework that added two more characteristics (Degree of discrimination and Dynamic pricing strategy) to the five existing dimensions (SBIFT).

Another pricing framework was proposed by Lehmann and Buxmann [9] with the following pricing parameters: Price formation, Structure of payment flow, Assessment base, Price bundling, Price discrimination and Dynamic pricing strategies.

The described classification of options available for software companies in designing product strategy demonstrates the importance of carrying out complex analysis of software product strategy. This analysis involves taking product strategy as a portfolio of interrelated solutions, rather than as a set of independent managerial decisions.

5 Concluding Remarks

This paper is devoted to the matters of importance and challenges facing software industry in designing software products strategy and, more precisely, in pricing. The dynamic model for market analysis was developed through illustrating how it works and how the model can be used. The proposed model as well as underlying theoretical framework seem interesting and highly promising. The next important step demands a large and wide empirical research to test and confirm the above mentioned theoretical positions. So, this research will prove the applicability of the above mentioned approach to the software product strategy design by real companies.

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Publication II

Saltan, A. and Smolander, K.

**Bridging the State-of-the-Art and the State-of-the-Practice of SaaS Pricing:
A Multivocal Literature Review**

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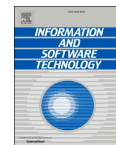
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Bridging the state-of-the-art and the state-of-the-practice of SaaS pricing: A multivocal literature review

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ABSTRACT

Context: Pricing is an essential element of software business strategy and tactics. Informed pricing decision-making requires the involvement of different stakeholders and comprehensive data analysis. Achieving both appears to be challenging, and pricing remains one of the most under-managed processes in the software business. Simultaneously, a coherent SaaS pricing body of knowledge and verified solutions to assist SaaS providers while designing and implementing pricing are missing.

Objective: There is a lack of integration among different research areas focused on SaaS pricing and, more importantly, between academia and industry. The primary aim of this paper is to clarify this misconception by classifying, thematically analyzing, and putting in correspondent academic state-of-the-art and industrial state-of-the-practice of SaaS pricing.

Method: A multivocal literature review (MLR) approach was used for the study, exploring both “white” literature as well as “grey” literature. The body of literature of 387 bibliography items was collected using a formal protocol. Of these, 57 were white literature items, and 330 were grey. A multistage content analysis process was implemented to classify the rich literature body across multiple dimensions with further mapping, synthesis, and reporting.

Results: A taxonomy of pricing-related concepts was created. It classifies SaaS pricing aspects, affecting factors, and challenges facing SaaS providers. The findings and interpretations are summarized to emphasize the major research themes and practical challenges of SaaS pricing practices’ transformation and provide further research guidelines in this area.

Conclusion: SaaS pricing is a maturing and prominent area of research that requires further investigation. The conducted MLR formed a clear picture of SaaS pricing research and practice and identified different SaaS pricing aspects and affecting factors. The study will enable both scholars and practitioners to assess the current state-of-the-art in research and practice.

1. Introduction

Software-as-a-service (SaaS) is a software licensing and distribution model in which software is hosted by service providers and is made available for customers over the Internet. According to the latest analytical reports, the SaaS market revenue is forecasted to grow to \$104.7 billion in 2020 [1]. The real revenue could be even higher as the COVID-19 pandemic accelerates SaaS services’ adoption by companies and individuals to address the increase in remote work and the demand for business agility [2]. By now, more than 82% of businesses use at least one SaaS solution, and the number of companies that use SaaS and the

number of SaaS solutions used per company are both growing constantly. This rapid growth makes SaaS the largest public cloud computing market segment and the primary software licensing and delivery model globally [3].

A base case scenario of the SaaS model assumes remote access to the software on a subscription basis rather than buying a license and installing the software on local computers and servers. The software itself is owned, developed, and managed by an SaaS provider. Two types of SaaS providers can be identified: traditional software vendors and tech companies (e.g., SAP, Google, Adobe), and new “born-in-the-cloud” SaaS companies who usually have just one flagship SaaS solution, such

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as Salesforce add Dropbox [4]. The fast transition of large companies towards these models, and the explosive growth in the number of new pure SaaS companies, is driven by significant benefits offered for SaaS providers. Still, these benefits come with business and technical challenges. The market landscape changes, which requires software companies to design and implement fundamentally different business models, product management practices, and development processes for their SaaS solutions, from those at the age of pure on-premise software products [5].

Pricing is an essential, crucial, and challenging element of product management and business strategy. By SaaS pricing, we denote the overall scope of the decisions, practices, underlying conditions, and processes in determining the monetary value of the offered SaaS service. Even a small change in the SaaS service price may significantly, positively or negatively, impact companies' financial performance. Defining the price for a product or a service is part of a comprehensive pricing management strategy that companies have to handle. Efficient pricing management requires sophisticated decision-making and analytics, as well as coordination and finding compromises between the many business functions involved. Many companies find this challenging [6].

Facing the above-mentioned pricing challenges, large software and tech companies employ economists who cooperate with product and project managers to address all their products' pricing challenges, including SaaS solutions [7]. However, a wide range of newly established SaaS providers, most of which are small- and medium-sized enterprises, have the resources and knowledge to make informed decisions on pricing strategy, tactics, and implementation operations. Inconsistent knowledge of SaaS pricing and complications in establishing and managing all pricing-related processes and practices results in a scattered and under-managed pricing process for many SaaS providers [6].

Haphazard SaaS pricing in the software industry is mirrored in academic literature. Since its inception, SaaS and all its associated aspects, including pricing, have become topics of interest for scientists in various research domains. SaaS pricing has gained significant attention in many research domains, including economics, management science, and marketing, as well as software engineering and computer science. However, the lack of a single "home" for studies on software and SaaS pricing in the academic community has resulted in isolated pricing-related studies with diverse and inconsistent approaches and recommendations. As a result, the current theory does not sufficiently assist practitioners in selecting from among the many options while designing and implementing the pricing of their SaaS solutions [8]. The primary research goal was to address this issue by answering the following three research questions: (1) *What is the current status of academic research and practical expertise in SaaS pricing?* (2) *How is SaaS pricing defined and disseminated by scholars and practitioners?* and (3) *How the research outcome and practical expertise can support SaaS providers in pricing their products?*

We searched for articles from both pricing practitioners and scholars. Combining these two sources of publications in this systematic multivocal literature review, allowed us to explore existing pricing frameworks and systematize the diverse range of recommendations and guidance grounded in research or practical experience. Following the guidelines on conducting multivocal literature reviews (MLRs) [9], we explored the available academic literature on SaaS pricing across various digital libraries and databases, as well as accessing materials produced by practitioners and industry experts outside the traditional academic community. The body of literature included 57 items of white literature (WL) and 330 items of grey literature (GL) published since 2001, when the concept of SaaS was introduced¹.

SaaS pricing research should provide a body of knowledge that offers appropriate SaaS pricing solutions and designs to product managers

based on the parameters and objectives of a given situation. Putting together pricing frameworks, step-by-step solutions, and easy-to-use decision support mechanisms, could assist product managers and, in the long run, improve industrial SaaS pricing practices. This study contributes to the development of a body of knowledge on SaaS pricing by comparing and systematically analyzing the existing literature. The study matches industrial state-of-the-practice with academic state-of-the-art to make suggestions about promising paths for future research. Practitioners can benefit from understanding how industrial practices can be improved from these academic studies. The study also provides a better understanding of the interplay between software product management and software engineering.

The rest of this article is organized as follows. Section 2 discusses related work. Section 3 illustrates the methodology, research questions, and scope of our systematic study. Section 4 presents the results of our study. Section 5 discusses the results and limitations of our study. Section 6 concludes this article by presenting the findings, implications, and directions for future work.

2. Background and rationale

In this background section, we define the concept of SaaS and identify the issues of SaaS pricing. We also give a brief overview of existing SaaS pricing reviews and overviews.

2.1. The concept of SaaS

The idea of centralizing computational power and application hosting with machine time-based paid access, was first implemented by computer service bureaus in the 1960s [10]. The appearance of personal computers enabled the replacement of this model by the on-premise software model, which offered the ability to purchase a perpetual license and install a copy of the software on a local computer. However, the development of the internet has led to another delivery model of commercial software – the software lease model. The consumer is entitled to use the software product via the Internet or a "thin client," where the software is owned and operated by an application service provider (ASP) [11]. The provider can produce the software itself or buy the software from a developer. The provider operates and maintains the servers that run the software. Before the year 2000, this was not very widely accepted or adopted by small and medium-sized enterprises (SMEs), individuals, or large corporations despite the attractiveness of the idea itself [12]. In the late 2000s, with further development of the Internet, the ASP model re-emerged under the notion "software as a service" and as part of the cloud computing paradigm.

The acronym SaaS was first invented in 2001 by the Software & Information Industry Association (SIIA) [13] to describe a model where: "... the application, or service, is deployed from a centralized data center across a network – Internet, Intranet, LAN, or VPN – providing access and use on a recurring fee basis. Users "rent," "subscribe to," "are assigned," or "are granted access to" the applications from a central provider." However, the most common and generally accepted definition is the one presented in 2011 by the United States National Institute of Standards and Technology (NIST) [14]. First, NIST defined cloud computing in general as: "...a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction." Further, SaaS itself is defined as one of three models. The other two are platform-as-a-service (PaaS) and infrastructure-as-a-service (IaaS).

Specifically, SaaS is "the capability provided to the consumer to use the provider's applications running on the cloud infrastructure" [14]. The applications are accessible with various devices through a web browser, a thin client interface, or an application. The consumer does not manage or control the underlying cloud infrastructure, except for limited user-specific application configuration settings. NIST also lists

¹ Selected WL and GL items, including extracted fields, are presented in the online supplementary appendix available at <https://bit.ly/3dQXK9M>.

the following five essential characteristics of SaaS [14]: on-demand self-service, broad network access, resource pooling, rapid elasticity, and measured service. The NIST definition of SaaS is quite technical and focuses primarily on the deployment and delivery aspects of the SaaS model.

Outside the information systems and software engineering domains, scholars have discussed economics, business, and behavioral issues of using various forms of online software-intensive services from a non-technical perspective. Instead of SaaS, a variety of names are used in publications without providing a clear definition and relying on a commonsense understanding (i.e., “cloud services” [15], “information services” [16]).

2.2. SaaS pricing

Consolidating the variety of different definitions provided by scholars and practitioners [17–19], we define pricing as the process of decision-making in determining the monetary compensation and related conditions of the goods and services the customer is offered. Pricing serves as an essential bridge between different business functions (i.e., product management, revenue management, cost management, retention management) and business units (i.e., R&D, production, sales, marketing). The decision-making in pricing is based on an integrated analysis of different perspectives and streams of information. Pricing is an essential element of the business model and product strategy. All this applies also to SaaS. Before exploring existing knowledge on the role of pricing in SaaS companies, we overview the concept of pricing and its application to the software industry in general.

While the price has been the central element of economic theories for centuries, the concept of pricing as a managerial discipline and business function dates back to the late 1970s. It arose as a result of the deregulation of the airline industry which provided flexibility for airline companies in defining prices for airline tickets [20]. Back then, pricing was considered as a part of revenue (or yield) management, defined as the processes and practices of selling “the right inventory unit to the right type of customer, at the right time, and for the right price” [21]. Efficient revenue management required comprehensive decision-making regarding these four “right” aspects, with the goal of maximizing revenue streams. Since then, a considerable amount of management literature on revenue management has been published, exploring its evolution and variation among industries and even among companies within the same industry [22].

Another important pillar of any business model and strategy is cost management [23]. The cost structure and its management practices vary significantly across industries. Aligning revenue and cost management practices is essential to ensure profitability and long-term sustainable development.

The software industry has unique characteristics of revenue, pricing, and cost management. First, revenue management in the software industry is mostly about defining “right pricing” and “right customers”. The timing of production and inventory are of little importance. Second, most software companies have a considerable disparity between fixed costs and variable costs, which creates supply side economies of scale [24,25]. These two unique characteristics make pricing a key driver for market success and revenue growth for software companies.

While the commercial success of software companies is very dependent on an adequate pricing strategy; decisions on designing and implementing a pricing strategy have always been challenging for software companies [26]. If there is a lack of focus in pricing at strategic, tactical, or operational levels, the product and the company are likely to fail. The transition towards the SaaS business model has enabled new opportunities for software companies in software development, delivery, and operation. These opportunities have implications for pricing by creating and magnifying the number of pricing design, experiment, and control methods available. These methods include, for example, recurring subscription fees, new methods to ensure efficient price

discrimination, and real-time usage tracking [27]. However, these new opportunities can also cause obstacles for companies when old pricing principles and practices become obsolete, and companies’ understanding of how the new ones should be designed is unclear [28].

The unique characteristics of software as a product and the software market [29], require tighter alignment between pricing management and development processes than in any other industry. Moreover, pricing is considered as an integral part of software product management and corresponding responsibilities [30,31].

2.3. SaaS pricing reviews

The crucial importance of pricing for businesses has promoted research in this area. The number of academic publications on SaaS pricing topics has grown as the adoption of this new model has increased. However, as it will be proved below, SaaS pricing research remains at a level far below the importance of this topic for practice. There is an evident lack of a systematic investigation of the development and current state of this research area. While background sections of several research papers (i.e., [32,33]), and several literature reviews (i.e., [34,35]) have highlighted certain aspects of SaaS pricing research, they have covered only a narrow part of the literature. In fact, we were able to identify only one systematic review that examined SaaS pricing [36]. However, this publication had a broader scope, explored all three cloud computing models, and was based on a market research perspective. In this study, we target the lack of systematic reviews on SaaS pricing. Our aim is to obtain a clear picture of SaaS pricing, its different approaches, and pricing methods employed.

3. Research methodology

This MLR focuses on SaaS and its pricing across various research domains and types of studies. Our objective is to identify the state-of-the-art and the state-of-practice in SaaS pricing. We also want to provide a basis for further research in SaaS pricing. We do not limit the scope of the study to a systematic review of academic publications (white literature, WL). Instead, we also incorporate an extensive body of grey literature (GL) in the analysis. Following [37,38], we refer to publicly available knowledge artifacts in both digital and printed formats, which can also be produced outside academic publication channels. GL publications considered for this research include, but are not limited to, discussion and white papers, blog posts, reports, web-pages, and magazine articles. WL includes publications in academic venues that are prepared through a formal peer-review process. These include scientific journal articles, conference proceedings, working papers series, and monographs.

The research protocol for the study is based on the guidelines for performing systematic and multivocal literature reviews and mapping studies [9,39,40]. The formal research process is presented in Fig. 1.

3.1. Research questions

To get an integrated, transparent, and fresh look into the research and practice of SaaS pricing, this study focused on answering three broad research questions *RQ1–RQ3*, with several clarifying sub-questions per question. Following the classification scheme discussed in [9,41]), all three research questions (with corresponding sub-questions) can be classified as exploratory ones.

RQ1: What is the current status of academic research and practical expertise in SaaS pricing?

RQ1.1: What is the total number of GL and WL publications on SaaS pricing and how has the number of publications evolved over time?
RQ1.2: Who are the leading scholars and practitioners in this area, and what venues are used for publications?

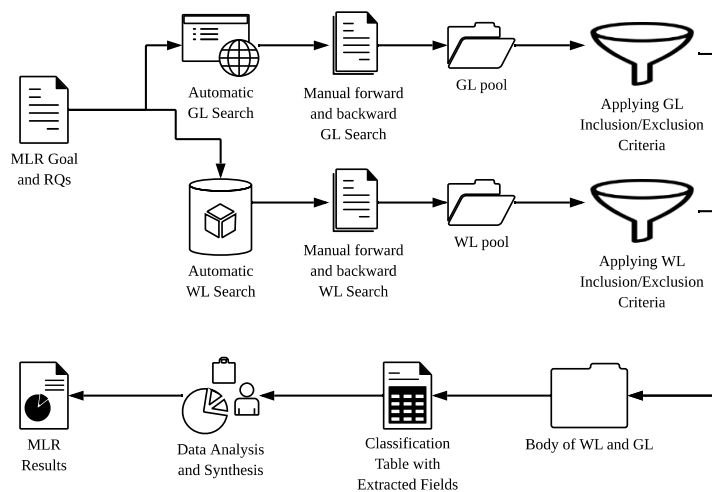


Fig. 1. MLR research process.

RQ1.3: What research and analytical methods have been adopted in the existing literature?

RQ1.4: What types of SaaS and SaaS markets are considered, and what companies are used as case studies?

RQ2: How has SaaS pricing been defined and structured by scholars and practitioners?

RQ2.1: What are the objectives and the role of pricing in the business of SaaS companies?

RQ2.2: What aspects of SaaS pricing are identified and addressed in the existing literature and how can they be classified?

RQ2.3: How is SaaS pricing structured and dissected in existing literature?

RQ2.4: How are SaaS pricing-related terms introduced and defined by scholars and practitioners?

RQ3: How can the research outcome and practical expertise support SaaS providers in pricing their products?

RQ3.1: What are the primary challenges facing SaaS companies in designing and implementing pricing?

RQ3.2: What factors affecting SaaS pricing are identified in the existing literature and how can they be classified?

RQ3.3: What SaaS pricing decision-support frameworks, if any, have been proposed and how do they vary?

The main idea behind **RQ1** is to provide a broad overview of SaaS pricing as an area of research and practice. The first two sub-questions (*RQ1.1* and *RQ1.2*) focus on evaluating the distributions of publications based on source type, date, authorship, and venues, as primary indicators of interest of scholars and practitioners and the area's level of maturity, narrative, and focus. From different perspectives, the next two sub-questions (*RQ1.3* and *RQ1.4*) assess how comprehensive and multifaceted the current knowledge and expertise in the area is.

With **RQ2**, we identify how scholars and practitioners understand and systemize SaaS pricing. We start with identifying SaaS pricing objectives (*RQ2.1*) and aspects addressed in these publications (*RQ2.2*). We then assess how SaaS pricing can be structured (*RQ2.3*), and assess the common vocabulary of terms associated with SaaS pricing (*RQ2.4*).

The last research question **RQ3** investigates the practical implication of current knowledge on SaaS pricing and whether existing publications offer reliable support for decision-making. Firstly, we identify the main

challenges and pain points of SaaS pricing (*RQ3.1*). Secondly, we identify factors that should be taken into account while defining and implementing the pricing of SaaS solutions (*RQ3.2*). Finally, *RQ3.3* identifies and compares existing decision-making frameworks.

3.2. Research scope

The overall primary research scope driven by the formulated research questions was identified using Population, Intervention, Comparison, Outcomes (PICO) criteria [40]:

Population: The notion of SaaS was first introduced in 2001[9]. Therefore, we looked for papers published between 2000 and Q3 2020. We did not limit the publication venue and considered both WL, that is, articles in peer-reviewed journals and conference proceedings, and GL, that is, textbooks, monographs, technical reports, blog posts, and discussion boards [9].

Intervention: We took the following actions to produce a relevant MLR: collected the prime body of literature, performed data extraction and classification, and conducted synthesis and analysis in a form that allowed us to provide answers to research questions *RQ1–RQ3*.

Comparison: The MLR study compared various issues and aspects regarding SaaS pricing across multiple dimensions. By analyzing the extracted information, we were able to summarize current knowledge in the field of SaaS pricing. We considered a cross-domain analysis of trends in research and practice, contribution, and challenges, as essential to our objectives. Both similarities and differences were used to identify the potential for further studies as well as to highlight improvements to SaaS pricing practices in the industry.

Outcome: The collected body of literature represented a wide-ranging coverage of existing studies and practical observations and ensured the comprehensiveness and authenticity of the study. The MLR provided a clear overview of SaaS pricing, including identifying the key challenges across domains and proposing further research directions to address them.

3.3. Source selection and search strategy

Defining the research questions and research scope was followed by determining sources and search strategy. Given the vast body of

literature regarding the research topic, the data collection routine was based on automatic queries across multiple scientific databases and digital libraries, as well as Google and Google Scholar search engines. The literature review consisted of two stages of searching. Search procedures were defined according to the PICO criteria. In the first stage, we collected WL using multiple scientific databases and digital libraries. In the second stage, we collected GL following a similar protocol, using the search engines mentioned above.

At both stages, we employed similar search query strings. They were constructed in order to retrieve the most relevant results on issues related to SaaS pricing. We defined the following search string as a combination of keywords and operators, and used it to perform searches in databases, digital libraries, and search engines:

("SaaS" OR "software-as-a-service") AND ("pricing" OR "price" OR "revenue" OR "costs" OR "fee" OR "charge").

The stopping criteria [9] were quite similar for both types of literature. We bounded the efforts by considering only the first 300 search database engine hits. Additionally, we ensured that, by that threshold, we had an evident theoretical saturation, and that relevant publications stopped appearing.

3.3.1. The first stage: WL search

We selected the following scientific databases and libraries that cover the most significant journals and conference proceedings: ScienceDirect, SpringerLink, Scopus, JSTOR, IEEE Xplore, and ACM Digital Library. The search procedure was conducted in September 2020. To ensure the exhaustiveness of the collected body of literature, we complemented the automated search with a backward and forward chaining manual search, using both the Google Scholar search engine. While we screened all identified initial studies for ACM Digital Library, IEEE Xplore, ScienceDirect, and JSTOR, we relied on the ranking algorithm for SpringerLink and considered only the first 300 items. However, relevant results stopped showing up after we screened the first 200 items, and we did not find any relevant items among the last 50 considered items. Scopus and Google Scholar were used for validation of the relevance of the collected body of literature and for capturing possibly missing items for the body of literature. For Google Scholar, we used the same principle as with SpringerLink and considered only the first 300 items. As in SpringerLink, we did not find relevant items among the last 50 items, which suggested that there was no need for a further search. All identified papers were first screened using the inclusion criteria (IC), which helped to identify papers that met the research scope:

- 1 Full texts of the paper are available,
- 2 Published in peer-reviewed journals or conference proceedings,
- 3 The study is not a duplicate of another study, and
- 4 The study covers any aspect of SaaS pricing.

To ensure that we were not missing any significant part of the study, we supplemented the automatic search across scientific databases and digital libraries with a so-called backward and forward chaining search for the first 50 publications, based on the number of citations in Google Scholar. This approach allowed us to identify papers that either did not focus on SaaS pricing, but still covered certain aspects and provided valuable insights, or used various synonyms of the term SaaS (i.e., "cloud services," "online services," or "information services") while discussing issues relevant to SaaS pricing. After the initial body of WL collection was completed, the following exclusion criteria (EC) allowed us to exclude irrelevant papers based on the full-text analysis:

- 1 The study does not specify in which way the research contributes to a better understanding of SaaS pricing or improving SaaS pricing practices,

- 2 The study does not provide clear evidence for its results, and
- 3 The study only reviews existing studies without providing substantial analysis and synthesis.

As a result, the final collected body of WL consisted of **57** items stored for further data extraction and analysis.

3.3.2. The second stage: GL search

Using the Google search engine instead of scientific databases and digital libraries, we employed the defined search query and explored the first 300 web resources identified. We manually evaluated them using the following IC:

- 1 The publication is publicly available on the Internet,
- 2 The publication is a standalone publication written under a real name or the name of an organization,
- 3 The publication content is original, and its length exceeds 250 words, and
- 4 The publication covers any aspect of SaaS pricing, apart from just the importance of pricing.

For those publications that met the ICs, we conducted a manual search using internal navigation and search mechanisms on the web site. Often, a web site contained more than one publication related to SaaS pricing. In the same way, we did not include short publications (usually blog posts in the form of a comment), nor did we include books, reports, or magazines as a single item of GL. We divided lengthy publications (i.e., books or magazine issues) into sections, chapters, or articles, in order to have a more homogeneous body of literature. Finally, we manually added 13 items of GL (white papers/reports) identified through the Google Scholar search that were not included in the cohort of WL. After the initial body of the GL collection was completed, we applied the following EC for a full-text analysis to exclude publications from those that have already been included:

- 1 The publication does not offer details on the design or implementation of SaaS pricing,
- 2 The publication does not include industrial cases or other factual evidence, and
- 3 The publication only reviews existing materials on SaaS pricing issues without providing conclusions with substantive value.

As a result, the final collected body of GL consisted of **387** items stored for further data extraction and analysis.

3.4. Data extraction and analysis

After we completed the search procedures, the body of literature consisted of **387** items. We employed a multistage procedure to extract the information needed to provide answers to the defined RQs. The list of extracted fields assigned with the RQs is presented in **As previously** mentioned, all three RQs along with corresponding sub-questions, are exploratory ones. Answers to the research sub-questions RQ1.1-RQ1.4 were obtained using statistical analysis. We calculated the required indicators, visualized them, and explored the received distributions and trends. Based on the analysis, we provided observations that were further used to define suggestions for further research and to answer RQ1 in general.

Providing answers to research sub-questions RQ2.1, RQ2.2, RQ3.1, and RQ3.2, required classification and synthesis in addition to the statistical analysis. The first part of the analysis was carried out as part of the data collection. Based on the extracted raw data, we constructed a classification for various SaaS pricing issues with a repeated extraction procedure to fill the classification tables. The second part of the analysis involved assessing the frequency distribution of various SaaS pricing issues and comparing them across different dimensions, including types

of publication and publication venue. Similarly to the first group of research sub-questions, we also provided observations that were further used to define research gaps and to propose research directions to fill the gaps.

Answers to the rest of the research sub-questions were mostly formed by combining, integrating, and comparing information extracted from the body of literature. Definitions for various terms associated with SaaS pricing were constructed (RQ2.4), and existing SaaS pricing taxonomies (RQ2.3) and decision-making frameworks (RQ3.3) were compared.

Table 2. If possible, data extraction was performed automatically; however, most of the fields required manual extraction. To mitigate subjectivity and biases, fields WL11/GL11–WL18/GL18 were extracted using a multi-step procedure as follows:

- 1 First, we manually filled in these fields with all the relevant information available in publications;
- 2 Second, we analyzed all collected manual inputs and systematized them. For most of these fields, we developed a classification. We were not able to do it for all fields as these issues were not discussed in the vast majority of publications and the collected info did not provide sufficient grounds for such generalization (i.e., SaaS pricing business role and objective, WL11/GL11); and
- 3 Finally, we read the publications for a second time to fulfill classification for the fields where we were able to develop classification and to ensure that we are not missing any relevant information.

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Providing answers to research sub-questions RQ2.1, RQ2.2, RQ3.1, and RQ3.2, required classification and synthesis in addition to the statistical analysis. The first part of the analysis was carried out as part of the data collection. Based on the extracted raw data, we constructed a classification for various SaaS pricing issues with a repeated extraction procedure to fill the classification tables. The second part of the analysis involved assessing the frequency distribution of various SaaS pricing issues and comparing them across different dimensions, including types of publication and publication venue. Similarly to the first group of research sub-questions, we also provided observations that were further

Table 1
Selected search sources and collected items.

Digital library/ database	Web address	Initial number of publications	Final number of publications	
			WL	GL
ACM Digital Library	http://dl.acm.org	12	7	-
IEEE Xplore	http://ieeexplore. ieee.org	107	15	-
ScienceDirect	http://www. sciencedirect.com	31	22	-
JSTOR	https://www.jstor. org	351	13	-
SpringerLink	https://link. springer.com	4 607	34	-
Scopus	https://www. scopus.com	278	37	-
Google Scholar	https://scholar. google.com	94 700	42	42
Google	https://google.com	121 000 000	-	302
Forward and backward search			10	21
TOTAL (without duplicates)			57	330

Table 2
Data extraction fields.

Research question	Extracted field code	Extracted field
RQ 1.1	WL1 / GL1	Publication title
RQ 1.2	WL2 / GL2	Publication year
	WL3 / GL3	Publication author(s)
	WL4 / GL4	Publication venue / source name
	WL5 / GL5	Publication type
	GL6	Source type
RQ 1.3	WL7 / GL7	Research / analytical approach
RQ 1.4	WL8 / GL8	SaaS category
	WL9 / GL9	Types of customers
	WL10 / GL10	SaaS companies
	WL11 / GL11	SaaS pricing business role and objectives
RQ 2.1	WL12 / GL12	Considered SaaS pricing aspects
RQ 2.3	WL13 / GL13	Proposed SaaS pricing schemes and typologies
	WL14 / GL14	SaaS pricing-related terms and concepts, and their definitions
RQ 3.1	WL15 / GL15	SaaS pricing challenges
RQ 3.2	WL16 / GL17	Factors affecting SaaS pricing
RQ 3.3	WL17 / GL17	SaaS pricing decision-making frameworks structure

used to define research gaps and to propose research directions to fill the gaps.

Answers to the rest of the research sub-questions were mostly formed by combining, integrating, and comparing information extracted from the body of literature. Definitions for various terms associated with SaaS pricing were constructed (RQ2.4), and existing SaaS pricing taxonomies (RQ2.3) and decision-making frameworks (RQ3.3) were compared.

4. Analysis and results

In this section, we analyze the collected body of WL and GL from different perspectives, defined by the research questions specified in 3.1. Results are summarized in a form of 14 Preliminary Empirical Conclusions (PECs).

4.1. Current status of academic research and practical expertise on SaaS pricing

RQ 1.1. What is the total number of GL and WL publications on SaaS pricing, and how has the number of publications evolved over time?

The distribution of the studies by year, and belonging to WL or GL is presented in Fig. 2. It shows that SaaS pricing is a widely discussed topic among scholars and practitioners. In 2003, the first academic paper devoted to the issue of pricing strategy for SaaS was published. The authors used the term “web-enabled application services” [42]. However, the second paper on SaaS pricing, in chronological order, was only published three years later, in 2006. Starting that year, SaaS became the primary term for the new and promising licensing and delivery model. The first GL publication we found dates back to 2009. However, it is possible that some publications have been removed from websites or were published on websites that no longer exist.

The number of publications, including both GL and WL, has been growing annually (for 2020 we identified only publications published between Jan-Sep). However, the trend in the number of publications is opposite for GL and WL. While the number of WL studies is declining, the number of GL studies is increasing. The total number of GL publications far exceeds the number for WL. Currently, most publications (330 items, 85%) on SaaS pricing belong to GL. Even though we excluded publications with fewer than 250 words, most GL publications are still relatively short blog posts expressing the author’s opinion on a particular aspect of SaaS pricing.

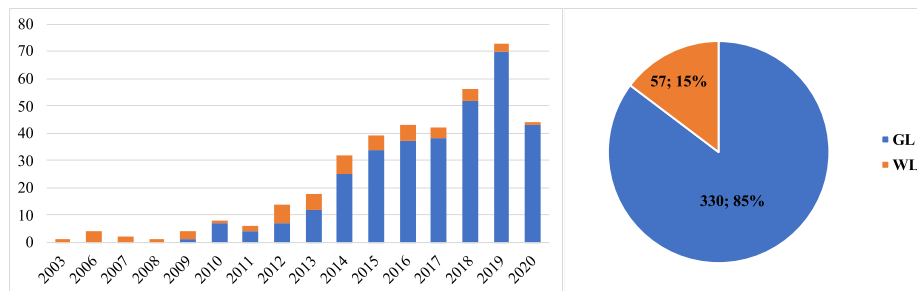


Fig. 2. Distribution of the collected publications by year (left) and publication type (right).

PEC #1: The number of WL publications per year is declining, indicating a decline of interest by scholars to pursue this topic. However, the number of GL publications is growing.

PEC #2: There is an imbalance between the amount of GL and WL, with a low number of publications by scholars and a high number of publications by practitioners.

RQ 1.2. Who are the leading scholars and practitioners in this area, and what venues are used for publications?

Table 3 lists leading scholars and practitioners in the field of SaaS pricing. Lists of scholars and practitioners by themselves do not provide much insight besides naming who is working in the field. It is noteworthy that only one scholar was a co-author in more than five publications. Among practitioners, we noted a group of experts actively publishing and sharing their experiences on various SaaS pricing-related topics. The analysis of the awareness of the scholars with regard to the practitioners' activities and vice versa, brought insightful results. We did not find any citations of GL publications in academic papers. Similarly, we found no citations of WL publications in GL publications. Practitioners frequently mentioned different studies (i.e., behavioral economics [43–45], and general marketing [44,46]), but never dedicated studies on SaaS pricing. Additionally, we did not find any GL publications co-authored by scholars.

Table 4 lists the leading publishing venues for SaaS pricing research and Internet resources used by practitioners. The rest of the WL venues not listed in the table have just one publication; for GL, we listed all venues with the number of publications above five. The list of venues

confirmed the interdisciplinary nature of the research in SaaS pricing. While we found that examples of multidisciplinary conferences and journals that accept publications from different research domains, research on SaaS pricing, in general, was fragmented, and there were very few cross-domain citations. Our findings also showed that studies on SaaS pricing can be published in highly ranked journals in management science and information systems. At the same time, the high diversity of publication venues of existing SaaS pricing studies and the absence of special issues in journals, may indicate a lack of venues for SaaS pricing research.

We also classified both WL and GL publications by type (Fig. 3). We identified three types of WL: journal article, conference proceedings, and working paper. The variations of GL appeared to be more numerous. We classified all GL publications into the following four groups: Web-page/Blog post, Presentation/Infographics, White paper/Company report, and Book section/Magazine article. Some companies position their white papers and reports as books or magazines of their own (i.e. [47,48]). Despite that we classify them as White paper/Company report. A Book section/Magazine article is published by an independent publisher in our classification. In WL, the share of conference proceedings (25 items, 43%) slightly exceeded the number of journal articles (27 items, 47%) and working papers (6 items, 10%). The highest share of GL was found in blog posts (307 items, 92%).

We also classified GL based on the source type. We identified the following six sources of SaaS pricing publications: SaaS provider blog, consulting company blog/journal, venture capital company blog/journal, media website/industrial magazine, industrial conference/event presentation/speech, and personal blog. The distribution of GL publications based on the source type is presented in Fig. 5. Consulting companies' blogs and reports had the most publications (157 items, 47%). While leading consulting companies (i.e., McKinsey, Bain, PWC) published in this area, consulting companies actively sharing knowledge in pricing are relatively small and are usually highly specialized. The second largest share of GL publications (86 items, 26%) was prepared mostly by SaaS companies offering help for SaaS providers and other digital companies, in pricing- and revenue-related activities (i.e., billing, customer analytics, pricing design).

PEC #3: Absence of any cross-references between WL and GL and scarcity in cross-references between research domains.

RQ 1.3. What research and analytical methods have been adopted in the existing literature?

Both WL and GL publications employ a diverse range of research and analytical approaches. We used the following classifications for our research approaches (Fig. 6):

- 1 Case study and in-depth survey,
- 2 Design science and action research,

Table 3
List of leading scholars and practitioners.

WL Author name	Number of publications	GL Author name	Number of publications
Ojala, A.	5	Campbell, P.	30
Li, M.	4	Murphy, L.	17
Zhang, Z.	4	Poyar, K.	15
Laatikainen, G.	3	Tunguz, T.	12
Ma, D.	3	Lemkin, J.	10
Nan, G.	3	Forth, S.	9
Buxmann, P.	2	Mele, C.	9
Cao, R.	2	Shelley, E.	6
Cheng, H.	2	Pena, N.	6
Jiang, Z.	2	Smith, E.	6
Lehmann, S.	2	Balaji, S.	6
Mehra, A.	2	Harvey, K.	6
Bala, R.	2	Wise, W.	5
Seidmann, A.	2	Dimova, P.	5
Sun, W.	2	Guo, V.	5
Tan, Y.	2		
Zheng, Y.	2		

Table 4
List of leading publication venues and sources.

Venue / source name	Venue / source type	# of publications
WL		
Social Science Research Network (SSRN)	Working Paper Series	5
International Conference on Software Business	Conference	4
Information Systems Research	Journal	2
International Conference on Information Systems	Conference	2
International Journal of Advanced Computer Science and Applications	Journal	2
Journal of Management Information Systems	Journal	2
Journal of Revenue and Pricing Management	Journal	2
GL		
OpenView Partners	Venture capital company	37
PriceIntelligently	Consulting company	36
Sixteen Ventures	Consulting company	17
Chargify	SaaS provider	14
PayMotion	SaaS provider	14
Redpoint Ventures	Personal blog	12
Fusebill	SaaS provider	12
SaaSr	Consulting company	11
Chargebee	SaaS provider	11
Cobloom	Consulting company	10
Klood Digital	Consulting company	10
Software Pricing Partners	Consulting company	9
Medium	Media website / Industrial magazine	9
ChartMogul	SaaS provider	7
Lighter Capital	Venture capital company	6

- 3 Quantitative research,
- 4 Simulation and stochastic modeling, and
- 5 Overview, literature reviews, and mapping studies.

In line with this, the largest share of WL publications (31 items, 54%) use economic models to investigate what pricing strategies that software companies who offer SaaS should follow, using market determinants, product characteristics, and market equilibrium as factors. The second-largest share (11 items, 19%) of academic publications included literature reviews on SaaS pricing or overviews of industrial practices. Most of these studies provided taxonomies of SaaS pricing practices with a discussion and basic descriptive statistical analysis. All studies except one [36] were conducted in a non-systematic way.

We used the following typology of analytical approaches based on the analysis of the GL pool:

- 1 Experience sharing – the prime goal of the publication is to clarify certain SaaS aspects or challenges related to SaaS pricing based on the authors' personal experience or inside information from a particular SaaS company.
- 2 Opinion sharing – the prime goal of the publication is to clarify certain SaaS aspects or challenges related to SaaS pricing based on

rational reasoning or outside observation of particular SaaS companies.

- 3 Overview and systematic observation – the prime goal of the publication is to list, overview, or compare various pricing aspects and methods.
- 4 Solution proposal – the prime goal of the publication is to provide a systematic recommendation or framework to support the SaaS pricing decision-making processes.
- 5 Survey and questionnaire – the prime goal of the publication is to share the results of a survey with SaaS companies.

The distribution of GL publications using the analytical method is presented in Fig. 7. Only 21 (6%) GL publications framed their ideas, knowledge, and experience in any structured way that could be called a solution (framework or decision-support tool). Many publications were generated by consulting companies and individual experts. While they were ready to share for free their observations and provide advice, systematic solutions developed by them were available from a paid consulting service or paid training. Additionally, just 6 (2%) publications presented the results of the performed surveys with other experienced professionals and SaaS executives.

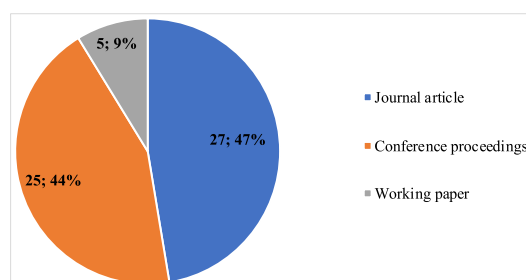


Fig. 3. Distribution of the publication by type for WL.

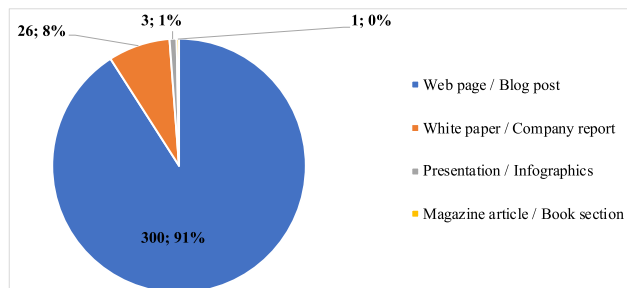


Fig. 4. Distribution of the publication by type for GL.

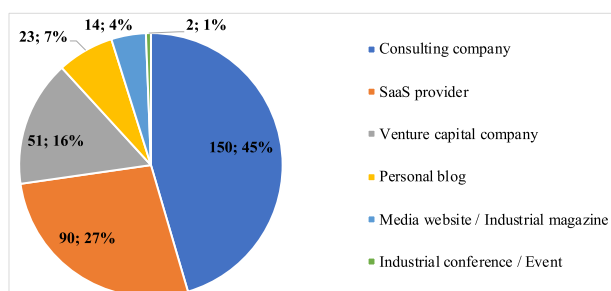


Fig. 5. Distribution of the GL publication by source type.

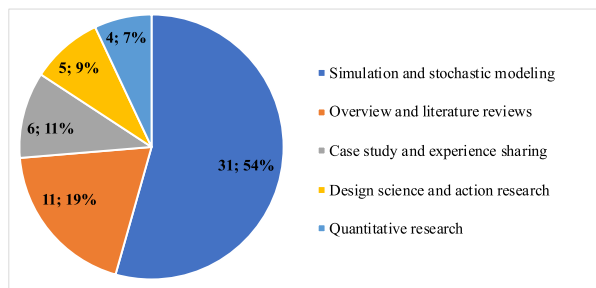


Fig. 6. Distribution of the WL publication by research approach employed.

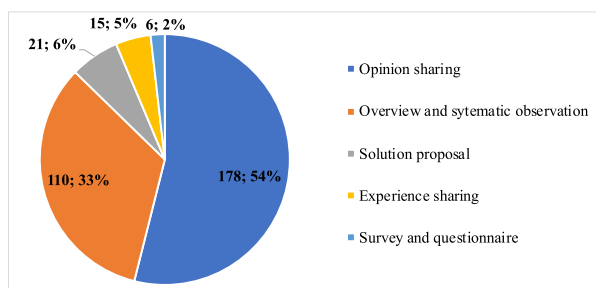


Fig. 7. Distribution of the GL publication by analytical approach employed.



Fig. 8. A word cloud for the companies used as examples in GL publications.

4.2. Definition and structure of SaaS pricing by scholars and practitioners

RQ 2.1. *What are the objectives and the role of pricing in the business of SaaS companies?*

RQ 2.1. *What are the objectives and the role of pricing in the business of SaaS companies?*

Existing studies on general pricing management revealed the vast range of objectives that can be targeted by product and service com-

panies in different industries and markets [51,52]. We adopted their classification of pricing objectives in the SaaS context. They included 13 objectives across three broad categories: *Market*, *Company*, and *Customer*. We further assessed which of these objectives were identified as relevant within the collected body of literature. Table 5 illustrates these findings, and heat mapping, based on frequencies, allows visual assessment of their relevance.

Visualization of their mentioning frequency is shown in Fig. 8.

The role and organization of pricing in SaaS companies have not been explicitly addressed in academic literature and are seldom discussed in publications by practitioners either. Yet, we found GL publications (i.e., [48]) that addressed this topic. Another discussion on the role of pricing in the organizational context proposed in [6], suggested that pricing is a bridge between a different business function and

Table 5
SaaS pricing objectives.

		WL Items	WL %	GL Items	GL %
Market	Market share maximization	13	23%	17	5%
	Welfare maximization	4	7%	0	0%
	Creating entering barriers	1	2%	0	0%
	Winning the competition	6	11%	18	5%
Company	Revenue/profit maximization	42	74%	92	28%
	Cost coverage	8	14%	46	14%
	Sustainable development	1	2%	26	8%
	Capacity utilization	0	0%	1	0%
Customer	New customer acquisition	0	0%	27	8%
	Customer churn reduction	1	2%	23	7%
	Monetization of existing customers	0	0%	27	8%
	Fair matching customers value perceived	7	12%	33	10%
	Piracy reduction	3	5%	1	0%

recommends organizing a special pricing committee.

PEC #7: Existing academic studies provide a quite narrow view of the objective of SaaS pricing. They do not describe the role of pricing in the organizational context. Practitioners deliver a more comprehensive, but still disorganized vision of pricing roles and objectives.

RQ 2.2. What aspects of SaaS pricing are identified and addressed in the existing literature?

The identified GL and WL cover a wide range of SaaS pricing aspects. We categorized all these pricing aspects into four categories. The first three categories are related to organizational levels and are titles as *Strategic Level*, *Tactical Level* and *Operational Level*. The fourth category of *Overall pricing* cover publications that discussed more general issues, including pricing concepts, trends, and ethical issues. Within these four categories, we identified 12 pricing aspects. The classification of SaaS pricing aspects is presented in Table 6.

Scholars in WL and practitioners in GL mainly focused on aspects that we assigned to Strategic level and accorded other categories less attention. WL covered almost no aspects related to pricing tactics and pricing processes. A diverse range of recommendations on Tactical level aspects grounded in psychology, sociology, and behavioral science are widely discussed in GL. However, scholars did not approach these with verification and systematization. Similarly, pricing strategy design, implementation, and control have not been popular topics in SaaS pricing research.

PEC #8: Research on SaaS pricing has mainly focused on general pricing issues and strategy design. There is little research on pricing

tactics and organizational processes in SaaS pricing as well as on the evolution and trends in SaaS pricing.

RQ 2.3. How is SaaS pricing structured and dissected in existing literature?

We identified nine different approaches to structure SaaS pricing. Four of them were proposed by practitioners (S1-S4) and three by scholars (S5-S9). These structural frameworks are presented in Table 7. The perspectives of the identified approaches vary. The first two (S1, S2) propose a typology of pricing methods as a pricing configurator. The authors identify the main SaaS pricing dimensions (parameters) and identify the variety of pricing methods within each of these dimensions. As a result, SaaS pricing is considered as a portfolio of selected pricing mechanisms. Frameworks S4–S9 classify pricing from an organizational point of view and define various areas. Most of them provide examples and typologies for identified pricing components. To assess the complexity of the proposed approaches, we explored what SaaS pricing aspects they cover (Table 8).

PEC #9: Scholars and practitioners introduced several approaches aimed to structure and dissect SaaS pricing from several perspectives. However, the proposed approaches are inconsistent with each other, and no information on their actual usage by SaaS providers has been disclosed.

RQ 2.4. What SaaS pricing-related terms are introduced and how are they defined by scholars and practitioners?

Our review revealed a confusing state of terminology in SaaS pricing research and practice. We were able to identify more than 10 different terms or concepts associated with SaaS pricing, including pricing

Table 6
SaaS pricing aspects.

		WL Items	WL %	GL Items	GL %
Overall pricing	Theory, concepts and trends	34	60%	13	4%
	Monetary and business goals and objectives	1	2%	54	16%
	Ethics and compliance	4	7%	2	1%
Strategic level	Competitive research and market positioning	11	19%	21	6%
	Market segmentation and value proposition	6	11%	71	22%
	Pricing structure, strategies and models	53	93%	157	48%
Tactical level	Offering design, versioning and bundling	6	11%	207	63%
	Transparency, promotion and communication	2	4%	95	29%
	Customer acquisition, retention and usage analytics	2	4%	19	6%
Operational level	Ownership, control and decision-making	4	7%	39	12%
	Performance measurement, testing and evolution	3	5%	71	22%
	Resources and costs planning and management	9	16%	32	10%

Table 7
Composition of SaaS pricing structure approaches

Code	Composition	Ref.
S1	Six pricing parameters: 1) Formation of price: price determination, degree of interaction 2) Structure of payment flow: single payment, recurring payments, combinations 3) Assessment base: number of pricing components, usage-dependent, usage-independent 4) Price discrimination: 1 st degree, 2 nd degree, 3 rd degree, multi-dimensional 5) Price bundling: offer, product, degree of integration, price level 6) Dynamic pricing strategies: penetration pricing, follow-the-free strategy, skimming strategy	[56]
S2	Seven pricing dimensions: 1) Scope: granularity of the offer (package vs. unbundling) 2) Base: information base that dominates the pricing decisions (performance-based, cost-based, value-based, competitor-based) 3) Influence: ability of buyers and sellers to influence the price 4) Formula: the connection between price and volume 5) Temporal rights: the length of the time period when the user can use the offering 6) Degree of discrimination: offering product/service for different buyers for different prices 7) Dynamic pricing strategy: changing the prices over time based on various factors	[57]
S3	Two-staged framework: 1) Pre-purchase phase: communication and transparency (competitors, vendor, market info); 2) Post-purchase phase: dynamism and service (loyalty loop, value proposition, pricing reassessment)	[49]
S4	Five pricing layers: 1) Value creation (efficiency, novelty, complementarity, lock-in) and Business case (ROI, cost price, price margin, KPI pricing), 2) Pricing structure (pricing model, software, services, billing & metering system, SLA), 3) Price and value communication (marketing channels, price list, feature list, service list value, proposition), 4) Price policy and Sales mechanism 5) Price level	[59]
S5	Four pricing segments: 1) Pricing strategy: pricing goals, portfolio analysis, overall strategy, segment-specific strategy, 2) Price formulation: overall pricing and policies, segment-specific pricing and policies, pricing data and rules, 3) Transaction management: opportunities and requests, prioritization and allocation, quoting and deal management, policy enforcement, 4) Performance management: compliance, pricing performance measurement and management, sales force and partner enablement	[58]
S6	Six-segment pricing canvas: 1) Customer segments (personas, needs) 2) Value proposition (the basis for pricing, price objects) 3) Cost structure 4) Competitors and market 5) Pricing strategy (pricing goals, positioning, differentiation, bundling, psychological price levers) 6) Price model (price objects, metrics, price points, price levers, price model, price validation)	[60]
S7	Three-component: 1) Pricing Models: the method by which a user pays to use your product and for how much (7 types) 2) Activation Models: the method by which a user starts using your product (5 types) 3) Pricing Strategies: the way your pricing model is presented and marketed (8 types)	[45]
S8	Four components: 1) Strategy: what is the goal of the price? 2) Philosophy: how does the company price relative to costs? 3) Structure: what is the pricing rubric? 4) Positioning: how best to communicate the price?	[61]
S9	Two-component pricing: 1) Pricing model (10 types) 2) Pricing strategy (5 types)	[62]

strategy, pricing model, pricing structure, pricing policy, pricing approach, pricing scheme, pricing philosophy, pricing mode, pricing practices, and pricing pyramid. The most widely used terms are *pricing strategy* (35% of GL, 57% of WL), *pricing model* (36% of GL, 34% of WL), and *pricing structure* (16% of GL, 9% of WL). Both scholars and practitioners often juggled with these terms and individually used their own terms in their publications without providing clear definitions. Table 9 summarizes the definitions and typologies we found.

Many publications in both WL and GL pools, provided lists of possible pricing strategies and methods, with hints about their applicability in different contexts (i.e., [63]). Such WL publications often lacked illustrative examples and discussion on the applicability of the identified or proposed pricing strategies/tactics in real-world environments. In comparison, GL publications tended to be less systematic and often did not provide clear definitions for discussed methods; still, they offered a broader range of such methods and almost always discussed real companies that had implemented such methods. Both WL and GL publications lacked systematic investigations of the applicability and incompatibility of these methods, depending on different market structures, product and company characteristics, and customers.

PEC #10: Scholars and practitioners seem to lack a coherent vocabulary of terms associated with SaaS pricing.

4.3. Practical implication of existing publications

RQ 3.1: What are the prime challenges facing SaaS companies in designing and implementing pricing?

Both scholars and practitioners repeatedly stated that pricing, especially in the case of digital goods, including SaaS, is a complex area. The majority of SaaS pricing studies, including theoretical reviews, quantitative and case studies, as well as microeconomic ones, did not clearly specify the challenges they aimed to address. In total, we were able to extract just five challenges briefly mentioned in GL and WL, as shown in Table 10.

PEC #11: Little is known about the challenges facing SaaS companies while designing and implementing SaaS pricing.

RQ 3.2: What factors affecting SaaS pricing are identified in the existing literature?

Table 8
SaaS pricing aspects coverage by structure approaches

		S1	S2	S3	S4	S5	S6	S7	S8	S9
Overall pricing	Theory, concepts and trends				●		●			
	Monetary and business goals and objectives									
	Ethics and compliance									
Strategic level	Competitive research and market positioning			●	●	●	●			
	Market segmentation and value proposition			●	●	●	●			
	Pricing structure, strategies and models	●	●	●	●	●	●	●	●	●
Tactical level	Offering design, versioning and bundling	●	●	●	●	●	●	●	●	
	Transparency, promotion and communication			●	●					
	Customer acquisition, retention and usage analytics									
Operational level	Ownership, control and decision-making									
	Performance measurement, testing and evolution			●						
	Resources and costs planning and management									

Table 9
Definitions of SaaS pricing-related terms.

Term	Definition	Typology	Ref.
Pricing strategy	"Pricing strategy is the way you price your products based on various factors, such as costs, business goals, market segment, the ability of consumers to pay, and the value you deliver"	Four types: 1) Premium (prestige) pricing 2) Penetration pricing 3) Economy pricing 4) Price skimming	[63]
	"A strategy is a plan you use to achieve your goals"		
	"Pricing strategy is the method of pricing a business uses to determine how much to sell their goods or services for"	Three types: 1) Cost plus pricing 2) Competitive based pricing 3) Value based pricing	[64]
	"Pricing strategy concerns the method of setting your price points in a way that establishes your product as competitive in the eyes of potential buyers"	–	[65]
	"Pricing Strategies: The way your pricing model is presented and marketed"	Eight types: 1) Positioning 2) Discounting 3) Anchoring 4) Charm Pricing 5) Bundling 6) Perks 7) Localization 8) Making a recommendation	[45]
Pricing model	"[Pricing] strategy: what is the goal of the price"	Three types: 1) Skimming, 2) Maximization, 3) Penetration	[61]
	"The goal of pricing strategy is to assign a price that is the monetary equivalent of the value the customer perceives in the product while meeting profit and return on investment goals"	–	[33]
	"Pricing Models: The method by which user(s) pay to use your product and for how much is called the pricing model"	Seven types: 1) Flat-Rate Pricing 2) Usage-Based Pricing 3) Tier-Based Pricing 4) User-Based Pricing 5) Feature-Based Pricing 6) Credit-Based Pricing 7) Hybrid Pricing	[45]
	"The pricing model is a method used by a company to determine the prices for its products or services. A company must consider factors such as the positioning of its products and services as well as production costs when setting the prices of its goods and services"	Eight types: 1) Per User Pricing 2) Per Storage Pricing 3) Per Feature Pricing 4) Freemium 5) Price Per Contact / Item / Unit or Tiered Pricing 6) Processor Time / Data Transferred (Pay as You Go) 7) Advertising 8) Broker Fee Pricing Model	[66]
	"Pricing structure fundamentally answers the question, "How much do I charge for my product?" by helping you determine the relationship between the value of your product or service (and especially how your customers perceive that value) and the costs incurred to create/provide it"	Seven types: 1) Singular/flat-rate pricing 2) Tiered pricing 3) Variable pricing 4) Tiered and variable 5) Per-user pricing 6) Usage-based pricing 7) Freemium	[65]
Pricing structure	"[Pricing] Structure: what is the pricing rubric?"	Three types: 1) Linear Pricing 2) 2 Part Tariff 3) 3 Part Tariff	[61]

Table 10
SaaS pricing challenges.

No.	SaaS pricing challenges	Ref.
1	Developing a coherent decision-making process within the company	[33,67–69]
2	The complexity of frameworks and models that should support decision-making	[70]
3	Lack of competences for performing required market, customer, and pricing analysis	[71–73]
4	Lack of proper information for the analysis	[74]
5	Market dynamics and uncertainty	[53]

Table 11
Factors affecting SaaS pricing

		WL Items	WL %	GL Items	GL %
Market	Market size and demand	8	14%	30	9%
	Market structure and competitors' positions	33	58%	44	13%
	Targeting types of customers and market segments	1	2%	34	10%
	Delivery and sales channels	7	12%	12	4%
Company	Dynamics of technological progress	1	2%	1	0%
	Business goals and opportunities	5	9%	13	4%
	Company size and maturity	1	2%	33	10%
	Ownership and financing	14	25%	0	0%
	Resources and competences availability	0	0%	8	2%
	Costs and cost structure	30	53%	56	17%
Consumers	Perceived value and willingness-to-pay	41	72%	82	25%
	Information asymmetry and customer uncertainty	2	4%	2	1%
	Customer satisfaction and loyalty	2	4%	7	2%
	Customer acquisition costs	0	0%	19	6%
	Adoption readiness	3	5%	13	4%
	Customer usage patterns	0	0%	1	0%
	Switching and migration costs	13	23%	10	3%
	Network effect	10	18%	8	2%
Product	Lifecycle stage	4	7%	27	8%
	Competitive advantage	3	5%	7	2%
	Functions and features	5	9%	77	23%
	Quality attributes	23	40%	8	2%
	Software architecture	4	7%	0	0%
	Lease and usage period	9	16%	6	2%

Only one academic paper explicitly investigated factors affecting SaaS pricing decision-making [75,76]. All other WL and GL publications only mentioned them while formalizing model assumptions, comparing different pricing strategies and models, or explaining possible lessons learned from a particular real-world case study analysis. In total, we were able to identify 24 factors that could affect the SaaS pricing strategy.

We further classified these into four categories based on the source of influence: *Market*, *Company*, *Consumers*, *Product*. The first two categories capture factors from the external environment, whereas the latter two categories are associated with the internal environment. These factors are presented in Table 11. As with SaaS pricing challenges, we found a gap in the coverage of these factors in WL and GL publications. Even more important, current studies do provide a quantitative or qualitative assessment of the impact of these factors on pricing performance and decision-making.

PEC #12: A wide range of SaaS pricing factors have been mentioned. However, not all factors have received much attention in academic literature, and the assessment of these factors' influence on pricing has never been systematically conducted.

RQ 3.3. What SaaS pricing decision-support frameworks, if any, have been proposed and how they vary?

We identified eleven decision-support SaaS pricing frameworks (F1–F11), one of which (F1) was proposed in WL and ten in GL. Several publications provided frameworks aimed to structure SaaS pricing and analyze that were already explored in RQ 2.3. While they might be useful in the decision-making, such frameworks do not explicitly guide product and pricing managers through the decision-making process. We did not include them in the analysis in this section. At the same time,

many publications provided an extensive range of non-systematic guidelines in a narrative form or recommendations regarding certain SaaS pricing aspects (e.g., [77]). We also did not include them and considered only structured decision-making frameworks. Characteristics and structures of identified frameworks are summarized in Table 12.

Proposed frameworks vary regarding covered SaaS pricing aspects (Table 13) that might affect decision-making. Publications presenting these frameworks did not offer any evidence of their implementations in practice. The question of their joint usage also remains open.

PEC #13: No single SaaS pricing decision-making framework addressed all SaaS pricing aspects, most of them assessed decision-making on a strategic level.

PEC #14: No information on actual usage of proposed decision-support frameworks by SaaS providers has been disclosed.

5. Discussion

In this section, we summarize and discuss our research findings and provide guidelines on further research in the SaaS pricing area aimed to close any identified research gaps. We also discuss our experiences of doing an MLR study on such a multidisciplinary topic as SaaS pricing and describe the limitations of the study.

5.1. State-of-the-art and state-of-the-practice in SaaS pricing

SaaS pricing is a topic of interest in several different research domains and has been explored from different perspectives. Besides classical economic, managerial, and behavioral schools of thought that can be identified in generic pricing research [9], SaaS pricing has received attention in engineering research communities, including software

Table 12
SaaS pricing frameworks.

Code	Framework focus	Framework structure	Ref.
F1	SaaS pricing development	Three-stage framework: 1) Data collection 2) Strategy analysis 3) Strategy establishment + Customer Reaction	[78]
F2	SaaS pricing development	Six-step framework: 1) What is the customer's value of the product? 2) Is the customer aware of this value? 3) Can the customer base be segmented? 4) Is the customer's demand variable or uncertain? 5) Establish a price floor 6) What are the value metrics that are most important to the customer?	[79]
F3	SaaS pricing development	Four-step framework: 1) Define upper bound: the max value the product has for customers 2) Define lower bound: the min amount needed to charge to cover products' costs 3) Identify reasons to charge less than your maximum value 4) Structure pricing model as a compromise between upper bound and lower bound	[80]
F4	SaaS pricing development	Five-steps framework: 1) Use qualitative and quantitative data to collect customer insights 2) Quantify your website personas with data findings from qualitative and quantitative research 3) Define your SaaS key value metric 4) Create SaaS pricing tiers a) Define the minimum amount a customer must pay to cover your costs b) Define the maximum amount a customer is willing to pay for your software c) Assess competitive pricing d) Map out your pricing tiers e) Align your value metric with pricing tiers based on buyer personas 5) Design Your Pricing Page a) Define the elements of your pricing page b) Optimize your SaaS page design	[81,82]
F5	SaaS pricing development	Four-step framework: 1) Industry benchmark, 2) Competitive analysis, 3) Economic value analysis, 4) Market research a) Qualitative method b) Qualitative method	[83]
F6	SaaS pricing development	Four-step framework: 1) Analysis 2) Straw man (Model) 3) Testing 4) Iteration and rollout	[84]
F7	SaaS pricing development	Seven-step framework: 1) Fundamental frameworks 2) Identifying metrics 3) Price options 4) Identifying target market 5) Quantifying value of Product 6) Understanding operational costs 7) Taking into account competitors	[48]
F8	SaaS pricing development and evolution	Three-stage framework: 1) Pricing at the Seed Stage 2) Pricing at the Expansion Stage 3) Pricing at the Growth Stage	[6,85]
F9	SaaS pricing changing	Four-step framework: 1) Market and customer research 2) Reviewing price options with a customer advisory panel 3) Run an impact analysis 4) Setting up a communication plan 5) Launch pricing	[86]
F10	SaaS pricing changing	Five-steps framework: 1) Agree on your new pricing 2) Communicate internally with all teams 3) Inform your existing customers 4) Transfer your existing customers 5) Communicate your price changes	[6]
F11	SaaS pricing changing/ problem-solving	Four-step framework: 1) Defining your growth problems 2) Determining the root causes 3) Testing your solutions 4) Implementation, then iteration	[22]

Table 13
SaaS pricing aspects coverage in decision-making pricing frameworks

		F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11
Strategic level	Competition and market research											
	Customer segmentation and value proposition	•										
Tactical level	Structure and models	•	•	•		•	•		•			
	Versioning and bundling				•		•			•		
	Transparency and communication				•					•		
Operational level	Customer and usage analytics				•					•		
	Ownership and decision-making											•
	Performance measurement and evolution						•		•		•	
	Feedback, monitoring and control						•					

product management, software engineering, and information systems.

Our review revealed that, since 2012, the number of academic publications published annually has been declining, and the total number of publications directly focused on SaaS pricing has been fewer than seven per year. Possible reasons for the declining number of WL publications may be that scholars do not see SaaS as a promising field of research or do not clearly understand the practice of SaaS pricing and its challenges. Scholars may also consider that all relevant aspects of SaaS pricing have already been studied, or that general pricing literature provides sufficient answers, and there is, therefore, no need for dedicated research regarding the SaaS context. However, the difference

between the number of WL and GL publications and the growing number of GL publications could indicate that much research is still missing.

These publications have employed different methods and covered various aspects of SaaS pricing. It became clear that academia has not delivered a coherent body of knowledge on SaaS pricing, and multiple research avenues remain open for further investigation. We believe that there is room for qualitative research, such as ethnography and grounded theory, because they would allow scholars to gain a first-hand, in-depth understanding of the intricate, context-specific processes of SaaS pricing, especially of their design and implementation. Also, generalization and verification of hypotheses quantitatively, grounded either in

Table 14
Summary of PECs and recommendations on SaaS pricing research.

No.	PEC	Recommendations
1	The number of WL publications per year is declining, indicating a decline of interest by scholars to pursue this topic. However, the number of GL publications is growing.	<ul style="list-style-type: none"> Academic research on SaaS pricing can advance pricing practices and contribute to the further sustainable development of the rapidly growing SaaS market. Scholars need to ensure that the research aim corresponds with pricing challenges facing SaaS companies
2	There is an imbalance between the amount of GL and WL, with a low number of publications by scholars and a high number of publications by practitioners.	<ul style="list-style-type: none"> Special issues and conference tracks on SaaS pricing and might provide incentives for scholars to perform such studies.
3	Absence of any cross-references between WL and GL and a scarcity in cross-references between research domains.	<ul style="list-style-type: none"> Scholars might consider non-systematic and often subjective recommendations and observations from the GL as a starting point for academic investigations Collaboration among scholars and experts in this area may promote further research and increase the value of practical implication of their studies. SaaS industry might benefit from scholars' proactiveness in sharing research findings in the SaaS pricing area with practitioners by being involved in preparing GL publications
4	The portfolio of research methods employed in academic studies presented in WL is mostly limited to theoretical modeling and non-systematic reviews.	To advance knowledge of SaaS pricing, a broader range of studies should be conducted.
5	Both GL and WL lack quantitative studies and extensive surveys	Range of studies on SaaS pricing might include large-scale quantitative studies based on extensive surveys and collect publicly available data and companies' datasets.
6	Scholars, unlike practitioners, tend to avoid contextualization of the research, assuming homogeneity of SaaS solutions, consumers, and markets.	Research can benefit from assessing the influence of different product characteristics and specific contexts on pricing.
7	Existing academic studies provide quite a narrow view of the objective of SaaS pricing. They do not disclose the role of pricing in the organizational context. Practitioners deliver a more comprehensive, but still disorganized vision of pricing roles and objectives.	Exploring the role of SaaS pricing and its objectives is essential step in further in further SaaS pricing research
8	Research on SaaS pricing has mainly focused on general pricing issues and strategy design. There is little research on pricing tactics, organizational processes, and practices in SaaS pricing.	Scholars should conduct studies to explore SaaS pricing tactics, organizational processes, and practices. Existing generic studies on pricing tactics and priciness processes could be reconsider and replicated in the SaaS context.
9	Scholars and practitioners introduced several approaches aimed to structure and dissect SaaS pricing from several perspectives. However, proposed approaches are inconsistent with each other.	Various SaaS pricing typologies and approaches need to be systemized to deliver a coherent meta-model of SaaS pricing
10	Scholars and practitioners seem to lack a coherent vocabulary of terms associated with SaaS pricing.	Pricing strategy research and practice will benefit from unified system of concepts and terminology that allow comparison of different pricing practices across the SaaS market.
11	Little is known about the challenges facing SaaS companies while designing and implementing SaaS pricing.	Scholars should reveal SaaS pricing challenges and address them in their studies
12	A wide range of SaaS pricing factors has been mentioned. However, not all factors have received much attention in academic literature, and the assessment of these factors' influence on pricing has never been systematically conducted.	Scholars should conduct studies to assess the influence of various factors on SaaS pricing quantitatively and qualitatively.
13	No single SaaS pricing decision-making framework can address the whole SaaS pricing problem due to the complexity of factors and their interrelations.	A systematization of different decision-support SaaS pricing frameworks is needed to assist practitioners.
14	No information on actual usage of proposed decision-support frameworks by SaaS providers has been disclosed.	Scholars need to ensure that proposed frameworks could be taken into account and employed by companies and implemented in a real-world environment.

Table 15
Recommendations for further studies on SaaS pricing.

No.	Research gap	Further research directions
1	Inconsistency in SaaS pricing area of research	<ul style="list-style-type: none"> Bridge the gap between product marketing-management and economics, on the one hand, and software engineering on the other.
2	Little is known about pricing practises in companies	<ul style="list-style-type: none"> Conduct longitudinal and exploratory case studies. Conduct large-scale quantitative studies based on extensive surveys and collect publicly available data and companies' datasets.
3	Research on SaaS pricing lacks contextualization	<ul style="list-style-type: none"> Develop a contextual theory of SaaS pricing.
4	There is little research on pricing tactics, organizational processes, and practices in SaaS pricing.	<ul style="list-style-type: none"> Conduct studies to compare SaaS pricing practices in different contexts. Examine existing generic pricing studies and reconsider them in the SaaS context. Conduct research to assess various pricing methods available for SaaS companies, including psychological and behavioral ones.
5	Lack of knowledge about the challenges facing SaaS companies while designing and implementing SaaS pricing.	<ul style="list-style-type: none"> Study practices and processes of pricing design and implementation in SaaS companies. Conduct studies to identify SaaS pricing challenges and provide solutions or recommendations.
6	Existing studies do not disclose the role of SaaS pricing in the organizational context and SaaS pricing objectives	<ul style="list-style-type: none"> Conduct studies to explore and assess organizational aspects of SaaS pricing. Conduct studies to assess the relevance of different pricing objectives and interdependencies between them.
7	Lack a coherent system of terms regarding SaaS pricing.	<ul style="list-style-type: none"> Develop a meta-model of SaaS pricing. Provide precise classification and definitions of pricing-related concepts and terms based on previous research and industrial practices.
8	Lack of research aimed to assess the influence and importance of various factors that affect SaaS pricing	<ul style="list-style-type: none"> Conduct studies on disclosure factors affecting SaaS pricing. Assess the influence of various factors on SaaS pricing quantitatively and qualitatively.
9	Lack of integrated SaaS pricing framework that might be used by SaaS companies in	<ul style="list-style-type: none"> Conduct a comparative analysis of existing frameworks from different perspectives. Employ design science and action research to deliver a decision-support model and tool.

theoretical models or findings of qualitative studies, would be beneficial for the field.

The current research appears fragmented and separated from practice. We found a wide variety of notions, terms, and concepts proposed in publications. However, the presented frameworks and models designed to support decision-making in SaaS pricing seemed to lack coherency. It was hard to find evidence that research findings are actually used by practitioners, and researchers seemed not to expect that to happen because they seldom made claims that their findings would be directly usable in the real world. The public landscape of GL confirmed the presence of promising niches for further quantitative and design science research.

The analysis of the GL publications indicated how SaaS pricing is essential for the industry. These publications have delivered a broad range of recommendations and observations on SaaS pricing. While the GL publications were less systematic, they still covered a broader range of SaaS pricing aspects. Unlike practitioners, scholars can offer more systematic and rigorously developed solutions and recommendations to support SaaS companies in their pricing.

By combining WL and GL publications' findings, we classified SaaS pricing aspects, objectives, affecting factors, and challenges facing SaaS providers. Both academic research and industry observation showed that there is no unified approach to define and implement pricing. The findings of the conducted MLR have been summarized to emphasize the major research themes and practical challenges of SaaS pricing practices' transformation. The PECs and recommendations of this study are summarized in Table 14. The next subsection provides guidelines for further research in this area.

5.2. Further research directions

Identified PECs allowed us to go further and explicitly specify research gaps, as well as provide recommendations for further research as summarized in Table 15. The provided research directions highlight promising research avenues, following which will fill the theory-practice gap and overcome the inconsistency in research on SaaS pricing.

5.3. Importance of GL in the study

MLR is gaining momentum in academic literature, especially in areas that are critical for both scholars and practitioners when there is a need for interdisciplinary investigations and different perspectives. MLR combines state-of-the-art research and state-of-the-practice expertise when there is a clear gap between academic literature and actual practice [10,87]. While MLR methodology has been widely used in medicine and education sciences, researchers in management and engineering recognized its value less than a decade ago [9,88]. To the best of our knowledge, this MLR on SaaS pricing is the first of its kind, not just in the area of SaaS pricing, but also in broader fields such as software product management, pricing management, and cloud computing in general.

This study began as a regular, systematic literature review intended to identify the current state-of-the-art on SaaS pricing. After the body of academic literature was collected, it became clear that the research on SaaS pricing is fragmented and inconsistent. It also became evident that the findings of existing studies would be of little use to real SaaS companies, and the research is separated from the extensive body of practical expertise. It convinced us to employ a multivocal methodology and assess not just the current state-of-the-art, but to match it with the state-of-the-practice in this area by conducting a literature review on both WL and GL. Below, we enumerate the ways, including GL, that enabled the identification of emerging research topics and provided a clear picture of the current body of knowledge on SaaS pricing. First, the MLR approach allowed us to identify gaps in the existing academic body of literature. For instance, we found that SaaS pricing tactics and organizational issues have not received proper attention among scholars, while they seem to be relevant to practitioners based on the GL analysis. Facing a lack of dedicated studies, practitioners have had to investigate general research on pricing tactics and organizational issues and intuitively conclude which research findings might be valid to the SaaS domain. Further research might close this gap.

Second, the MLR approach enabled us to provide a comprehensive taxonomy for different SaaS pricing-related aspects (i.e., objectives, factors affecting, methods available). Including GL made the range of opinions and pieces of evidence broader and allowed us to extend initial taxonomies based on WL. Evaluation of the importance and significance of different items within these taxonomies required additional research,

but it revealed the variety fully and helped us to meet the exploratory aim of this study. This would not have been possible without a thorough investigation of GL.

Third, GL brought contextualization to the SaaS pricing research. Most WL publications considered SaaS solutions as a homogeneous population without exploring the various products, markets, and consumer characteristics. GL publications showed that efficient SaaS pricing decision-making requires a deep understanding of the context. This led us to call for further contextualization of the research on SaaS pricing.

Finally, analytical methods and questions raised in GL publications have revealed several directions for future research. For example, we identified several GL publications with recommendations based on observing pricing pages of a large number of SaaS companies. While practitioners' publications did not go further than basic descriptive statistics, their findings suggested that a sufficiently better understanding of pricing practices and factors affecting these practices could be delivered by performing an econometric analysis on similarly collected data.

5.4. Challenges and limitations of the study

MLR is gaining momentum as a research methodology for managerial and engineering research, including software engineering and software product management. Several publications (i.e., [9,88]) proposed guidelines and recommendations for the research process. Still, we faced many challenges in the implementation of the study. Below we list these limitations and challenges and explain how we took precautions to minimize them.

First, finding relevant GL publications was more challenging than collecting WL from databases. Many publications created by practitioners are not public and searchable. While we were able to identify several publications by leading global consulting companies (e.g., PWC, McKinsey) or software giants (e.g., Amazon Web Services), much content was produced by individual experts or SaaS companies. Leading strategic consulting companies (e.g., BCG or Accenture) and other software giants (e.g., Apple and Google) have their own frameworks and approaches to pricing that could be useful for other SaaS companies. However, their approaches to pricing are not published and were not included in the scope of literature. Yet, the number of included GL publications proved to be sufficient to obtain a clear picture of the current state-of-the-practice.

Second, during the process of data extraction, we found that not many papers specified sufficient details to fulfill all required table fields. This might be quite typical for systematic literature reviews, but including GL, further complicated this issue. GL publications tend to be focused on conclusions and recommendations without providing a chain of evidence that led to these findings. In many cases, we had to complete the comparison table based on clues that were not completely clear, mainly when we extracted SaaS pricing aspects, objectives, and pricing affecting factors. Therefore, there may be some small inaccuracies in the inferred data, but we do not consider this as a threat to the validity of the findings. These potential inaccuracies cannot significantly change the whole picture.

Third, we considered only publications where it was clearly stated that the focus of the study or topic of the publication was the pricing of SaaS. As for WL, we did include papers from the economic and business domains that did not use the term SaaS, but still clearly expressed that their research subject met the SaaS definition. Nevertheless, we did not include papers on SaaS without a clear focus on pricing issues or papers on software pricing in general. The same criteria were applied to GL publications. We also did not include short blogs and social media posts. We remained confident that the amount of GL and WL included would be sufficient to deliver results that disclosed the state-of-the-art and the state-of-the-practice on SaaS pricing.

Finally, this research was carried out by two co-researchers. To ensure bias avoidance and the validity of the research procedure,

segregation of responsibilities was established between the two co-researchers. The first author was responsible for performing activities determined by the research protocol at all stages of the research, while the second author carried out monitoring/reviewing of the study at each stage, following a defined supervisory strategy. All collected information was publicly available for external auditing. Additionally, the article itself and its findings were further discussed with industry experts specializing in software product management and pricing.

6. Conclusions

Migration to the SaaS business model has pointed out the importance of pricing in ensuring software companies' success. SaaS pricing also impacts many processes inside a company, affects different business units, and requires sophisticated analysis. While understanding the complexity of pricing and its strategic role, many companies find themselves incapable of performing proper pricing and rely on a trial-and-error decision-making approach. The academic community has failed to equip the industry with trustworthy pricing approaches, frameworks, and guidelines. We also lack a systematic investigation of existing SaaS pricing practices that vary significantly across the industry.

To the best of our knowledge, this research is the first to compare state-of-the-art and state-of-the-practice of SaaS pricing. Using the MLR formal procedure, we collected 387 items of WL and GL that directly addressed SaaS pricing issues. We extracted information from the collected literature and synthesized it to provide answers to the questions of what the current status of academic research and practical expertise on SaaS pricing is (RQ1), how SaaS pricing is defined and disseminated in academic literature and considered by practitioners (RQ2), and in which way existing studies support SaaS providers in designing and implementing pricing (RQ3). While the primary aim was to raise the awareness of SaaS pricing issues and stimulate further discussion, we believe our analysis brought some clarity to the only just emerging body of knowledge on SaaS pricing.

We recognized gaps in the current research on SaaS pricing. These identified gaps are mostly related to the inconsistency among different perspectives, the limited scope of methodologies employed, and the lack of clarity on the real obstacles of designing and implementing pricing in SaaS companies. The analysis of WL and GL publications allowed us to propose a research agenda in the form of identified research gaps and recommendations for further studies as presented in Table 14 and Table 15.

Our further work will be aligned with the proposed recommendations and can be unfolded in two directions. First, we intend to perform a large-scale quantitative study on SaaS pricing practices in the software industry with available public information. This study will complement a survey among product managers in SaaS companies responsible for developing and implementing a pricing strategy. We plan to analyze the decision-making process, challenges faced, as well as models and methods used. Second, we aim to use a constructive and design science approach to develop an integrated decision-making framework that SaaS companies can use to establish pricing processes and practices. We intend to test the framework in SaaS companies further.

We also gained significant insights while conducting this MLR study. This methodology's enduring popularity is justified and understandable as it aims to identify new sources of evidence, knowledge, and expertise to the research in highly industrial relevant areas. However, including GL makes the research process more complicated and adds certain threats to validity. Within this paper, we have reported on the challenges that we faced while conducting our study on SaaS pricing and the steps taken to overcome them. This will hopefully help other scholars to avoid these challenges.

Declaration of Competing Interest

No.

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Publication III

Saltan, A. and Smolander, K.
**How SaaS Companies Price Their Products:
Insights from an Industry Study**

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How SaaS Companies Price Their Products: Insights from an Industry Study

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Abstract. Pricing is one of the business and product strategy elements to achieve both financial performance and competitive advantage. The transition towards the Software-as-a-Service model has unlocked new opportunities for pricing software products. Conflicting recommendations from existing studies and industry experts make it challenging for SaaS providers to design and implement the pricing of their services. SaaS providers have come a long way in adapting their pricing practices to the new paradigm that assumes the offering of service instead of selling software as a product. This paper explores how SaaS providers package and price their products by reviewing the pricing information of 220 SaaS providers. The study reveals that SaaS companies are relatively heterogeneous in the way they price their products and the pricing practices of SaaS providers within the same size and product type could differ sufficiently.

Keywords: Software-as-a-Service · SaaS · Pricing · Empirical research

1 Introduction

The transition towards the Software-as-a-Service (SaaS) licensing and delivery model has significantly impacted business and engineering practices and processes. The ability to provide customers with software solutions over the Internet, rather than selling distributable products, requires companies to reconsider their business model with a particular focus on pricing.

SaaS pricing has been addressed in recent academic studies and is also widely discussed by practitioners outside academia. Studies from different research domains, including economics, decision science, and software engineering, explored various SaaS pricing aspects. However, these studies include a range of views, and they are often separated from practice. As a result, we have a diverse range of SaaS pricing guidelines, solutions, and recommendations; but still, we do not know whether SaaS providers follow and implement them.

This paper presents the first results of an ongoing study to understand the status quo of SaaS pricing practices. Using data on 220 randomly selected SaaS companies, we empirically investigate contemporary SaaS pricing practices. More formally, the research question (RQ) that drives our research can be formulated as follows: *How do*

SaaS companies price their solutions? To find an answer, we take a closer look at nine pricing aspects identified in a recent multivocal literature review, grouped into three levels: Strategic, Tactical, and Operational [20, 21]. Working with open data provided by SaaS companies on their pricing pages allow us to assess aspects of SaaS pricing that have never been raised in academic literature before.

2 Background

SaaS pricing gained traction at the end of the 2000s when scholars from various fields started to investigate the new service-oriented software model, later called software-as-a-service. From the very beginning, it was apparent that the new licensing and delivery model would change the way a product will be offered, positioned, and priced. However, the way companies should set the pricing of their products was not clear, which became a more critical problem to solve with the drastic spread of the SaaS model.

Evidence of this intense interest can be found in the rapid growth of online publications about SaaS pricing, with diverse recommendations and opinions usually grounded in personal experience and non-systematic observations. However, there is not an abundance of empirical studies investigating the pricing practices of existing SaaS companies, especially from the quantitative perspective.

Lehmann et al. [13] use data of 295 SaaS providers to investigate the disclosure of pricing information on the websites of SaaS providers and the use of value metrics in defining the price. They identify three characteristics of SaaS providers and SaaS solutions that might affect pricing-related decisions: company size, age, and product category. The study reveals the difference in disclosing pricing information by small/young and large/mature providers. However, no statistically significant results regarding the usage of the metrics were obtained.

Laatikainen et al. [10] assess the pricing models of 54 cloud service providers (including 33 SaaS providers). They adapt the five-dimension generic pricing framework SBIFT (Scope, Base, Influence, Formula, Temporal rights) proposed in [8], to the cloud context, by adding two more dimensions relevant for cloud solutions: the degree of discrimination, and dynamic pricing strategy. The developed seven-dimensional framework is further used to classify cloud computing pricing models and identify generic pricing models of cloud providers. The study demonstrates that SaaS providers tend to have similar pricing models regarding specific pricing model dimensions.

Like the previous paper, Wu et al. [26] also propose a pricing framework that is further used to assess pricing practices of 353 SaaS providers. The cluster analysis confirms that SaaS providers prefer value-based pricing over other pricing strategies. However, they still try to make it straightforward to target a broad market.

Finally, Laatikainen and Luoma [11] use data collected from a survey, rather than manual website screening, to assess the evolution of internal processes of pricing practices. A statistical analysis of 324 responses concludes that the adoption of cloud technologies implies changes in pricing. The study also identifies and evaluates factors affecting the decision-making process and provides a rationality for companies' behavior.

Besides research papers, several reports published outside academic venues overview SaaS pricing practices empirically. Using data collected from a large number of SaaS

providers, Poyar, in his blog posts [17, 18], provides insights into how companies cope with SaaS pricing challenges and how pricing-related decision-making is organized. However, these publications are relatively narrow regarding the scope and the analysis of patterns discovered.

Brandall [2, 3] and Shelley [23, 24] use for their publications, in the form of blog posts, data collected by exploring pricing pages of SaaS providers. However, these reports focus on large numbers of different small features, which are often related to the visual representation (i.e., versions naming, color pallets used, version listing order, etc.) without specifying their importance or providing attempts to explain the rationale behind observed patterns.

Empirical publications authored by scholars and practitioners provide valuable insights into certain SaaS pricing aspects. However, all of them focus on a limited number of SaaS pricing aspects, while a full picture of how SaaS providers price their products is missing. This paper reports on the first results of ongoing research complementing existing studies in gaining a full picture of SaaS pricing.

3 Methodology

Multiple different ratings and listings of SaaS vendors, compiled with a wide range of criteria and goals (i.e., fastest-growing¹ or leading²), can be found on the Internet. We used the three most complete databases of SaaS companies available to define the sample of SaaS companies for the analysis. Table 1 contains information on these databases.

Table 1. Explored SaaS databases

Resource name	# of items	URL
Golden Research Engine	10 250	https://golden.com/list-of-software-as-a-service-companies/
GetLatka	4 369	https://getlatka.com
SaaS Mag	2 086	https://www.saasmag.com/saas-1000-2020/

The number of providers and solutions covered in these databases varies significantly, but partly this can be explained by the variety and blurred boundaries of the definitions of SaaS. Some of these databases include providers that develop and deliver software solutions and digital services that either could or could not be classified as SaaS, depending on the definition and criteria used. Examples of such services include IT managed services, proofreading and translation services, logistic and delivery services, and ride-sharing services.

We used data from these three databases to make a random sample of 220 SaaS providers for our research. For the purpose of our analysis, we considered only SaaS providers that meet the following criteria:

¹ <https://clockwise.software/blog/top-ten-fast-growing-saas-startups-to-follow/>.

² <https://www.datamation.com/cloud-computing/50-leading-saas-companies.html>.

- The SaaS solution meets the definition provided by NIST [16], which defines SaaS as the capability provided to a consumer to use a provider’s applications running on cloud infrastructure. This study does not consider video-on-demand services, social networks, search engines, and digital marketplaces as examples of SaaS services.
- The SaaS solution has a dedicated pricing webpage. For SaaS solutions included in the sample, we manually collected data from their websites.

The descriptive statistics of the SaaS solutions included are presented in Table 2.

Table 2. Descriptive statistics for SaaS providers sample

Parameter	Value	Number (percentage)
SaaS provider age (years)	Less than 5	7 (3%)
	5–10	104 (47%)
	11–15	66 (30%)
	15–20	28 (13%)
	More than 20	15 (7%)
SaaS provider HQ country	USA	153 (70%)
	EU	20 (9%)
	UK	15 (7%)
	Canada	13 (6%)
	Australia	8 (3%)
	India	7 (3%)
	Others	4 (2%)
Ownership structure	Private	196 (89%)
	Public	24 (11%)
Number of employees	1–10	13 (6%)
	11–50	74 (34%)
	51–250	86 (39%)
	250–1000	34 (15%)
	More than 1000	13 (6%)
Types of Customers	B2B	182 (83%)
	B2B and B2C	36 (16%)
	Others	2 (1%)

4 Analysis and Results

A recently performed multivocal literature review [20, 21] identified nine SaaS pricing aspects grouped in three broad categories: strategic level, tactical level, and operational

level. Our data analysis assesses SaaS pricing practices across these levels; however, the publicly available data provided on SaaS company websites sometimes reveals only part of these details.

4.1 Strategic Level of SaaS Pricing

The following three SaaS pricing aspects can be attributed to the strategic level:

- (1) **Competitive research and market positioning:** how a SaaS company, through pricing, shapes consumer perception of their SaaS solution and distinguish their solution from the solutions of competitors, if they exist;
- (2) **Market segmentation and value proposition:** how a SaaS company divides potential customers into segments and defines the benefits and value in the usage of their SaaS service with (or without) respect to these market segments;
- (3) **Pricing structure, strategies, and models:** how a SaaS company determines the objectives, logic, and structure of SaaS pricing, its terms of usage and pricing evolution principles.

Pricing practices within all three strategic aspects are rarely openly communicated by companies and are often subject to commercial confidentiality. However, an evaluation of pricing pages allows us to make certain conclusions on pricing strategies and models employed by SaaS companies.

Pricing Strategies and Models

SaaS pricing strategy is a complex concept without a shared and formalized definition. The pricing strategy can be considered as a portfolio of certain strategic decisions. Two decisions mostly widely discussed in the academic and non-academic literature are associated with the long-term price evolution and the foundation for pricing strategy formation. The first decision can select the following dynamic pricing options (based on [10, 14, 19]):

- **Penetration pricing:** SaaS solution is introduced at the lowest possible prices and then increased over time.
- **Skimming pricing:** SaaS solution is introduced at the highest possible prices and then decreased over time.
- **Premium pricing:** SaaS solution maintains the highest price in relation to competitors' possible prices over time.
- **Economy pricing:** SaaS solution maintains the lowest price in relation to competitors possible prices over time.
- **Non-dynamic pricing:** does not imply any strategic principle in price changes over time.

The second crucial decision related to pricing is determining the foundation, selecting from the following options (based on [4, 6]):

- **Cost-based pricing:** SaaS prices are defined based on costs and the cost structure the company faces while developing and delivering SaaS solutions.

- **Value-based pricing:** SaaS prices are defined based on the value the SaaS solution provides to the customers.
- **Competition-based pricing:** SaaS prices are defined based on prices offered by competitions for similar SaaS solutions.
- **Market-based pricing:** SaaS prices are defined based on market demand, especially with a lack of competition and consumers willingness-to-pay.

Assessing both decisions is quite challenging, and analyses of pricing pages cannot reveal all the possible details of what pricing strategies are used. Companies may also implement hybrid strategies as combinations of the available options. However, the vast majority of companies (**91%**) specify the value/benefits gained by consumers as the basis for defining the price of SaaS solutions and implicitly communicate it on their pricing pages. This can mean that companies implement value-based pricing or hybrid pricing strategies.

The concept of SaaS pricing strategy is closely connected with the concept of SaaS pricing models. The SaaS pricing model aims to structure and provide a clear algorithm for the calculation of prices based on the selected pricing strategy and various internal and external factors. The number of identified pricing models vary across existing publications. Based on [4, 5] we distinguish between the following models:

- **Flat-rate pricing:** SaaS is offered for a fixed amount of money.
- **Pay-as-you-go pricing:** SaaS payments depend on the usage metrics of SaaS.
- **Tiered pricing:** SaaS is provided in the form of several price points with a fixed number of features and usage conditions (i.e., number of items, transactions).
- **User-based pricing:** SaaS payments depend on the number of SaaS users for the same account.
- **Feature-based pricing:** SaaS payments are based on the number of SaaS features available.
- **Variable pricing:** SaaS payments are individually discussed.

Similar to pricing strategy, these models can be merged into hybrid ones. Our empirical analysis reveals that tiered pricing (**54%**) is the most used pricing model. Additionally, **27%** of companies develop and use hybrid models largely based on the tiered pricing model.

4.2 Tactical Level of SaaS Pricing

The following three aspects can be attributed to the tactical level:

- (1) **Offering design, versioning³, and bundling:** how companies translate strategic decisions into a range of concrete offers for consumers, consisting of specific obligations related to the work of the proposed service, if the specified conditions, including financial ones, are fulfilled
- (2) **Transparency, promotion, and communication:** how SaaS companies inform target customers about their SaaS offerings and perform activities aimed at increasing customer interest in using the SaaS solution
- (3) **Customer acquisition, retention, and usage analytics:** how SaaS companies, by means of pricing, manage the processes related to customer acquisition and retention.

Offering Design and Versioning

The two core and closely related activities within offering design are the determination of the number and functions of offered SaaS versions, and the definition of the prices consumers will be charged for their usage.

Our empirical analysis reveals that the vast majority of SaaS providers offer 3 or 4 versions (Fig. 1, left). This number includes free versions offered by some SaaS providers but does not include the opportunity to directly contact SaaS providers if the available offerings do not match customer requirements. Mature and large companies tend to offer a high number of versions as do companies that aim at both B2B and B2C markets.

We also calculated the average price increase ratio between adjacent non-free versions. For more than half SaaS providers, the range for this average increase ratio is from 2 to 3 (Fig. 1, right). We did not assess the correspondence between the increase in prices between versions with the functional/quality propositions behind these versions.

As discussed earlier, companies tend to use pure value-based pricing or hybrid strategies. In many cases, SaaS providers do not limit themselves to one value metric and use multiple ones aligned with each other. Exploring the variety of metrics used by SaaS providers led us to propose the following five type classification:

- **User-based metrics:** the price of using a SaaS solution depends on the number of users/accounts requested by the consumer
- **Function-based metrics:** the price of using a SaaS solution depends on the number of features, options, and functions available for the consumer
- **Usage-based metrics:** the price of using a SaaS solution depends on the intensity/depth of usage (i.e., the amount of cloud storage required, or number of transactions performed)

³ The notion of the SaaS version might mislead and require certain clarification as there are two different meanings and corresponding definitions for it. According to the first one, SaaS versions are identified as stages of the SaaS solution in a release lifecycle [22]. The second one defines versions as strategically developed configurations of SaaS solutions within the same lifecycle stage [14]. Within this study, we will follow the latter meaning and definition.

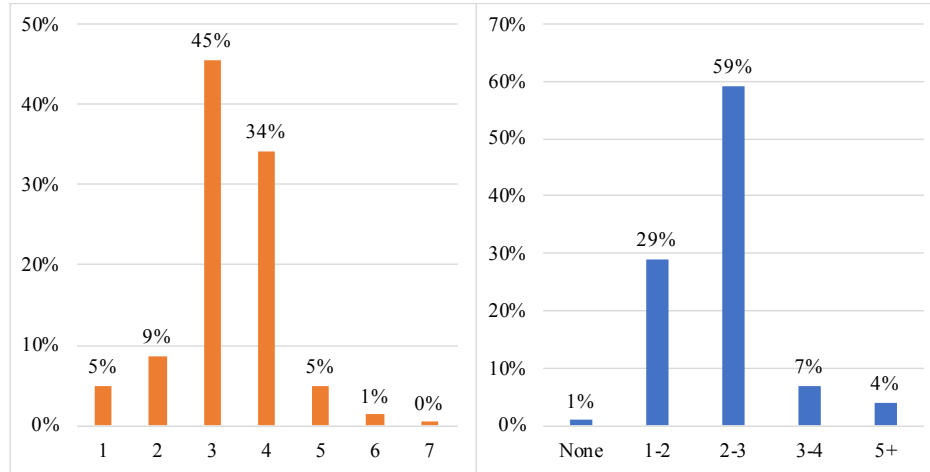


Fig. 1. Distribution of SaaS solution based on the number of offerings (left) and average price increase ratio between versions (right)

- **Consumer-based metrics:** the price of using a SaaS solution depends on the specific characteristics of the consumer (i.e., on the B2B market, consumer's revenue, or its size)
- **Outcome-based metrics:** the price of using a SaaS solution depends on the outcome achieved by using this solution (i.e., an increase in revenue or customer churn decrease).

Our empirical analysis reveals that the vast majority of SaaS providers use either user-based or function-based value metrics. The full picture of the distribution of SaaS solutions in our sample, with regard to the number of offerings, is presented in Fig. 2.

One particular type of versioning, called freemium, assumes offering the most basic version for free. This strategy has become popular and is widely employed in services targeted at the B2C market (i.e., music services, online games) [15].

Sixty-four SaaS providers (29%) implemented the freemium model by offering at least one version of their solution free of charge. Most of them operate in both the B2B and B2C market segments, and are large companies aiming to have a dominant market position. However, small- and medium-sized B2B SaaS providers do not implement freemium, giving a preference to free trial versions.

Unlike freemium, offering a free trial version also allows for generating purchase leads. The associated costs of a trial are less than in freemium due to the usage time constraints of the free trial version. The time constraint could be supplemented with limitations in the number of features or usage intensity. Our analysis showed that the vast majority (81%) of SaaS companies in the sample employ free trials.

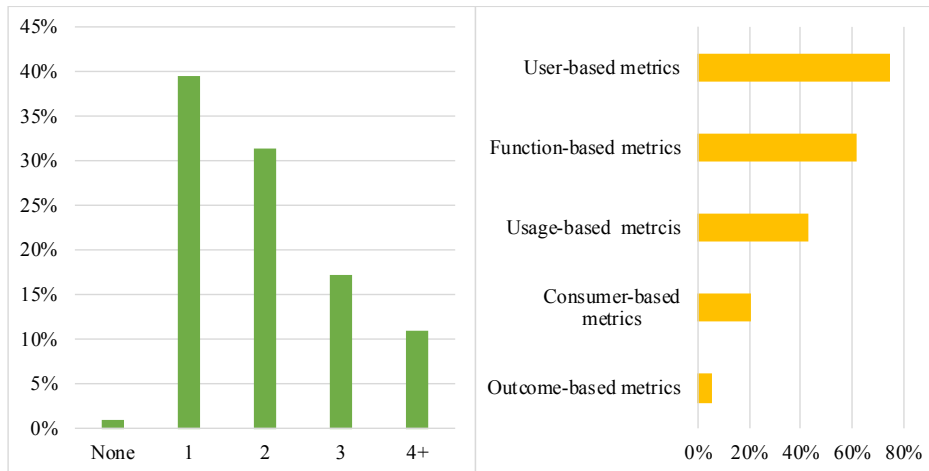


Fig. 2. Distribution of SaaS solution based on the number of value metrics used (left) and frequency of using different types of metrics (right)

4.3 Operational Level of SaaS Pricing

The following three aspects can be attributed to the operational level:

- (1) **Ownership, control, and decision-making:** how pricing-related decision making is organized inside a SaaS company and how responsibility for decision making is dispersed among the management team
- (2) **Performance measurement, testing, and evolution:** how a SaaS company assesses the performance and efficiency of their pricing and how the SaaS pricing changes over time and under internal and external factors and circumstances
- (3) **Resources, costs planning and management:** how pricing is aligned with the planning and management of resources and costs.

The data do not allow us to assess any operational level aspects of SaaS pricing.

5 Discussion

We compared our findings with theoretical and empirical studies on similar issues. Our main result is about the pricing strategy and model. Value-based and tiered pricing are the most widely used pricing strategies and models of SaaS providers.

Another result is about the number of versions the SaaS provider should offer. There are two distinct perspectives on the issue of versioning/offering design in the academic literature. The first one, which could be called economic, has its roots in price discrimination theory (e.g., [25]). It can be beneficial for SaaS providers to use a price discrimination mechanism by offering several versions, targeting different market segments and customers. Software companies conventionally employ variations of second-degree price discrimination by offering additional versions to the flagship one, with different functions/conditions, including corresponding changes in pricing. Versioning based on price discrimination can lead to the problem of cannibalization and possible loss of revenue. Consumers choose the more affordable option when more than one version is available.

The second perspective, which can be called behavioral, has its roots in theories of predictable, bounded rationality (e.g., [1, 9]). Consumer bounded rationality has two important implications for the versioning design. First, offering too many versions can make the selection process for consumers too complicated and eventually lead to loss of customers. The second implication is related to the pattern of how consumers make decisions when facing several options. The most well-known and empirically verified example of such irrationality states that regardless of the circumstances, with the choice of two offerings, consumers tend to select the cheapest one, while with the choice of three – the middle one [1]. SaaS providers can take advantage of such irrationality while designing their offerings and predict which offer will be in demand for consumers.

The perspectives and theories discussed above are quite generic and do not take into account all conditions of the SaaS business model and the underlying engineering practices and processes. However, they suggest implementing versioning with a number of versions which should correspond to the targeted market segments and take into account behavioral patterns. The observed pricing practices regarding the number of offered versions seem to be reasonable and correspond with these theoretical recommendations. The issue of using value metrics looks similar to the issue of versioning: SaaS providers need to find the optimal number and types of metrics that can estimate the value consumers gain from using a SaaS service. Studies on value-based pricing do not provide solid advice that supports or questions the appropriateness of the observed practices.

Finally, one of our observations is related to offering free options, primarily in the form of the freemium strategy. Table 3 summarizes the core advantages and disadvantages of following this strategy [7, 12, 15]. While there are promising benefits of implementing the freemium model, it might work only with SaaS providers that offer generic solutions targeting a broad market and different market segments.

Table 3. Advantages and disadvantages of using the freemium model

Advantages	Disadvantages
Purchase lead: In the long run, consumers who are using the free version might become paid ones	Cannibalization: there is a risk that consumers will not migrate to the paid version, being satisfied with the free one
Network effect activation: offering a free version might increase the value of the SaaS service for paying consumers and the price a SaaS provider might charge	Higher costs: freemium requires higher prices for paying consumers to cover costs associated with free ones
Better analytics: with a more extensive user base, SaaS providers obtain more usage data that can be used to increase the quality of the service	
Extra revenue options: freemium and the subsequently more extensive user base can be beneficial if a SaaS provider's revenue model assumes cash flows from supplementary services or advertising	

6 Conclusion

This paper reports ongoing empirical research on contemporary SaaS pricing practices. We overview existing pricing practices and supplement our results to discuss how they correspond with current pricing theories. We focused on aspects where conclusions can be made based on publicly available data presented on SaaS company websites. Our conclusions are related primarily to pricing tactics. Most strategic and operational aspects are unlikely to be reliably evaluated and assessed using open data from company websites.

The study reveals that SaaS companies are relatively homogeneous in the way they price their products. SaaS providers have come a long way in adapting their pricing practices to the new paradigm that assumes offering a service instead of selling software as a product. There is a shared vision of how SaaS solutions should be priced, and it is shared by most SaaS providers, which, however, does not lead to identical pricing practices. In this paper we concentrated on versioning design, the selection of value metrics, the usage of the freemium model, and offering users free-trial options. When compared to the limited number of existing empirical studies, all of which were published more than five years ago, we can observe and state that SaaS pricing is becoming more and more sophisticated. Most SaaS providers are offering multiple versions, designed and priced based on consumer value metrics. With all the promising benefits, the freemium model has not become widespread; most companies that employ this model operate on both B2B and B2C markets and offer generic solutions for a broad audience.

The study has limitations. We limit our analysis to regular descriptive statistics. Further steps after this descriptive analysis include performing a correlation analysis to determine how different SaaS pricing mechanisms influence each other, a regression

analysis to assess factors that might explain selected SaaS pricing practices, and a cluster analysis to develop a taxonomy of SaaS pricing practices.

The second limitation is associated with the sample. Based on the inclusion criteria, we did not consider SaaS providers that do not have a dedicated pricing webpage for their products. A lack of a pricing page can result from offering a SaaS solution for free or with an advertising-supported revenue model, or there can be an intention to initiate a negotiation with potential consumers and provide a unique value proposition to each consumer. Studies show that up to 50% of SaaS providers do not publicly disclose pricing information on their solutions [2, 13].

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Publication IV

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SaaS Pricing Practices Typology: A Case Study

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SaaS Pricing Practices Typology: A Case Study

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Abstract. Software-as-a-Service (SaaS) pricing addresses decisions of monetary compensation and the conditions for the SaaS solution to the customer. Efficient SaaS pricing requires sophisticated decision-making and analytics, as well as coordination and compromises between the many business functions involved. The decision-making includes integrated analysis of different perspectives and streams of information. Like in many other product management areas, there is no silver-bullet solution for pricing. We conducted a multiple case study using fifteen SaaS companies with data collection primarily through semi-structured interviews to assess SaaS pricing practices and identify major factors that affect the way pricing is done. We identified four distinct types of SaaS pricing patterns and detailed their main characteristics.

Keywords: Software-as-a-Service · Decision-making · Pricing · Case study

1 Introduction

Software-as-a-Service (SaaS) pricing refers to the entire scope of decisions, practices, underlying conditions, and processes that determine the monetary compensation for using SaaS solutions. It is an essential and challenging element of SaaS product management, with a significant impact on business success. Incorrect pricing can lead to market failure, even for a technologically advanced SaaS solution. Pricing serves as an essential bridge between different business functions (e.g., product planning and development, revenue and cost management, and customer acquisition and retention) and business units (e.g., R&D, product management, sales, and marketing). Recent studies and reviews indicate the progress and sophistication in SaaS pricing and the growing attention from practitioners. Multiple challenges for companies can still be identified that require support from the research community [1].

Overwhelming and complex pricing-related processes and structures, the unclear segregation of responsibilities for pricing between managers involved, premature decision-making practices, and constantly changing objectives are often prime challenges. Efficient pricing requires developing sophisticated multi-layered structures with many different mechanisms and options, considering the trade-offs, objectives, and outcomes that pricing must meet. Informed SaaS pricing decision-making requires the involvement of different stakeholders and the consideration of many factors that include market characteristics, product and technology specifications, customers, and customer

needs and expectations. Taking into account these factors requires collecting a vast amount of data and advanced analysis, tasks that are not trivial.

Existing publications by scholars and practitioners reveal the variety and complexity of mechanisms available for SaaS companies while pricing their solutions [2–5]. They also provide an overwhelming number of recommendations concerning different pricing aspects [1]. However, the repeated enumeration of possible pricing options and fragmented recommendations does not bring the required clarity to SaaS companies, and pricing remains one of the most under-managed functions in many of them. Little evidence exists about the interconnection of different components of SaaS pricing, typologies of overall pricing practices, or decision-making organization principles.

This paper aims to identify and evaluate patterns in SaaS pricing, identify the major factors that affect it, and propose a typology of SaaS pricing practices. This study continues our inquiry into how SaaS companies design and deploy their pricing practices and processes.

2 Background

2.1 Related Studies

SaaS pricing is a maturing and prominent area of research. Existing SaaS pricing studies indicate the progress and sophistication in SaaS pricing practices and offer solutions that can carry SaaS pricing state-of-the-practice to a higher level. Our recent multivocal literature review [1] identified multiple challenges that require further support from the research community.

Some studies have already adopted the case-study method to evaluate various pricing aspects in SaaS and software companies. For example, based on interviews with software professionals from multiple case companies, Ojala [6, 7] identified and assessed factors that affect selecting revenue and pricing models in software companies. In another study [8], Ojala and Laatikainen investigated the interrelation between SaaS architecture and SaaS pricing practices.

2.2 SaaS Pricing

Existing pricing state-of-the-art and state-of-the-practice suggest distinguishing between four main pricing strategies: value-based pricing, market-based pricing, competitor-based pricing, and cost-based pricing. In short, they can be explained as follows in the SaaS context. Value-based pricing assumes aligning prices with the value perceived by the customer. Market-based pricing is grounded in an analysis of the market equilibrium of all customers and SaaS providers. Competitor-based pricing assumes aligning prices with the prices offered by competitors with the premium or discount depending on the circumstances. Finally, Cost-based Pricing suggests setting prices based on the cost structure of SaaS providers. In application to SaaS, researchers and practitioners have repeatedly emphasized the advantages and importance of value-based pricing. However, all four pricing strategies might exist in practice, and in many cases, the actual strategy is a hybrid combination of these strategies.

Several frameworks and structures exist to organize and systematize pricing in application to SaaS and cloud solutions in general [1]. However, in our study, we adopted a more generic, widely accepted, and comprehensive one called the Strategic pricing pyramid [9, 10]. The framework has the following levels from the bottom up:

Value Creation: The logic of value generation for customers from using the SaaS solution, including the metrics of impact of specific parameters on value.

Price Structure: The logic of structuring prices for a given SaaS solution, including principles of price variability depending on the customer-specific parameters.

Price and Value Communication: The principles of price and value communication to customers.

Pricing Policy: The principles of how prices may be altered, by whom, under what circumstances, and to what degree.

Price Level: The actual charge within the price structure according to the pricing policy.

3 Research Method

The following research question drove our study: *What types of SaaS pricing practices can be identified in a real-life context?* To address this question, we used a multiple case study research design to compare existing SaaS pricing practices and processes [11]. The case sampling strategy was guided by the diverse case approach with its primary objective to achieve variance along the relevant dimensions. Our scope of companies includes two major types of SaaS providers, “born-in-the-cloud” companies that usually have just one flagship SaaS solution and large IT vendors or traditional enterprise software vendors looking to expand into SaaS software markets. Other dimensions, including company size and maturity, target market type, maturity, and location, were considered while selecting case companies.

We selected a set of fifteen primary and secondary cases. Our primary cases include companies whose pricing managers we interviewed. Most of them are “born-in-the-cloud” small and medium-sized companies that usually have just one flagship SaaS solution. We could not involve large US-based SaaS companies in our study, although their presence is essential to understand and develop a comprehensive SaaS pricing typology.

To remedy this situation, we decided to include cases that we did not interact directly with. We assessed their pricing practices through available information and teaching cases on their business strategies and operations. We referred to these cases as secondary and found them in the Case Center¹, the largest repository of teaching cases. This allowed us also to make assessments of pricing in large SaaS and digital companies as well as in enterprise software vendors with SaaS solutions in their product portfolio. An overview of the primary and secondary case companies is summarized in Table 1.

The goal is to identify decision-making practices and processes and understand the logic behind them. A within-case analysis was conducted with the analytical strategy of explanation-building based on case descriptions. The case analysis can be classified

¹ <https://www.thecasecentre.org/>.

as exploratory. We developed patterns and categories and identified similarities and differences in the data. The logical sequence followed the research goals, starting with within-case analysis to establish themes and then continued by a cross-case comparison to identify similarities and differences.

Table 1. Characteristics of case companies

Case	Case type	Number of employees	Number of SaaS solutions	Market type
A	Primary	<10	1	B2B
B	Primary	<10	1	B2B
C	Primary	<10	1	B2B & B2C
D	Primary	11–50	1	B2B & B2C
E	Primary	11–50	1	B2B & B2C
F	Primary	11–50	1	B2B
G	Primary	11–50	1	B2B
H	Primary	51–200	2	B2B
I	Primary	51–200	1	B2B
J	Primary	51–200	2	B2B
K	Primary	201–500	2	B2B
L	Primary	201–500	3	B2B
M	Secondary	51–200	1	B2B
N	Secondary	1001–5000	5	B2B & B2C
O	Secondary	201–500	3	B2C

For primary cases, the data collection consisted of interviews with SaaS managers responsible for pricing. The length of interviews varied from 1 to 2 h. The goal of the interviews was to identify the pressure points of decision-making in SaaS pricing, motivate companies to participate in the longitudinal study, and assess both the current status quo and product managers' perceptions of existing processes and practices. The data we obtained covered the following topics:

General information about the company and SaaS solution: name, industry, market, number of employees, number of customers, maturity level, business model, number of SaaS solutions, SaaS solution type, maturity level, etc.

SaaS pricing practices and processes: Pricing frameworks used, product activities allocation across business units, collaboration principles between business units, pricing tools used, SPM performance assessment principle, etc.

SaaS pricing decision-making principles: formal regulation and written policies on SaaS pricing activities, risks, and uncertainty identified, types of data collected for pricing decision-making, models and tools used to process provided data, information system support for pricing processes, etc.

For secondary cases, the data collection consisted of content analysis of the documented teaching cases and teaching notes to extract similar information.

4 A Typology of SaaS Pricing Practices

The qualitative research approach with semi-structured interviews allowed us to identify four major factors that affected SaaS pricing. The factors were the following:

Factor 1: types of customers and market segments targeted. We can distinguish between B2B, B2G, and B2C customers, as well as the size of targeted customers (especially in the B2B market).

Factor 2: delivered value and willingness to pay (WTP) for the SaaS solution. Specific estimates based on a limited number of cases are difficult to make; still, conventionally, we can distinguish between SaaS solutions with an average monthly usage fee of up to 100 USD, SaaS solutions with an average fee of more than 5000 USD, and those in between these two price levels.

Factor 3: the complexity of SaaS purchase and usage. We can distinguish between self-service SaaS solutions, SaaS solutions that might require human assistance in the purchase, customization, and maintenance, and SaaS solutions that require intensive human involvement, including offering additional professional and training services.

Factor 4: the level of nicheness of the SaaS solution. We can distinguish between mass-market SaaS solutions focused on solving problems typical for a wide range of customers and SaaS solutions focused on solving issues specific for customers from the same industry, country, or facing similar regulatory constraints.

Based on the analysis of these four factors, we developed a typology of four generic SaaS pricing approaches that we labeled *Mass-market SaaS pricing*, *Generalist SaaS*

Table 2. Typology of SaaS companies based on pricing practices

	Mass-market SaaS pricing	Generalist SaaS pricing	Specialist SaaS pricing	High-rise SaaS pricing
Case companies	C, D, E, N, O	I, L, M	A, B, F, J, K	G, H
F1: Targeted types of customers and market segments	B2C and B2B	B2B	B2B	Large B2B, B2G
F2: Perceived value and WTP	Low value and WTP	Low or moderate value and WTP	Moderate or high value and WTP	High value and WTP
F3: The complexity of SaaS purchase and usage	Self-service	Self-service	Moderate human involvement	High human involvement
F4: Level of SaaS nicheness	Mass-market	Mass-market	Niche-market	Niche Market

pricing, *Specialist SaaS pricing*, and *High-rise SaaS pricing*. While typology was based on our investigation of SaaS company pricing, it also appears reasonable from a general business model perspective as it represents different business models and pricing practices. These four pricing approaches are presented in Table 2 and described below.

Mass-market SaaS pricing refers to pricing practices often implemented in SaaS companies that offer mass-market solutions and operate in the B2C market and B2B market, focusing on small-sized companies. Such SaaS solutions might also be used in large companies as a part of private initiatives by small teams and individuals. The main pricing objectives for this type of pricing are customer acquisition, market share maximization, and winning the competition. A value-based pricing approach, to a large extent, is supplemented with market-based pricing. Companies of this type also often adopt the freemium model and a free model with monetization other than charging customers (i.e., advertisement). Adjusting for the level of company and SaaS solution maturity, the pricing-related processes can be highly formalized, driven by data analytics, and even automated.

Generalist SaaS pricing is often implemented in SaaS companies that offer mass-market services for customers on the B2B market, serving both small, mid-sized, and large companies. The main pricing objective for this type of pricing is customer acquisition, monetization and retention and winning the competition. Companies with this type of pricing employ a hybrid pricing approach based on a combination of value-based pricing and competitor-based pricing. While competing companies might evaluate and structure perceived value differently, the average amount of money charged per customer or account are quite similar. Instead of freemium in the case of mass-market SaaS pricing, companies with generalist SaaS pricing often use penetration pricing and sophisticated usage-based tiered pricing with multiple available options. Pricing-related processes are often formalized and driven by data analytics. Pricing automation may be employed; however, a sales team exists, and large companies can negotiate pricing individually.

Specialist SaaS pricing refers to pricing practices implemented by B2B SaaS companies that have a niche SaaS solution. The limited market requires more focusing on monetization and retention of existing customers with a high-quality service rather than acquiring new customers. Companies with this type of pricing implement value-based pricing in its canonical understanding with a fair match of prices to the value perceived. As a result, defining value metrics and assessing perceived value is crucial. However, most pricing-related processes are not usually formalized. Decision-making data can consist of direct feedback from customers. The basic pricing information might be publicly available; however, purchase processes typically involve interaction with the sales team.

High-rise SaaS pricing is implemented in companies aiming to serve large organizations with their SaaS solution. The main pricing objectives are customer monetization and retention along with sustainable business development. This type of SaaS pricing involves combining value-based pricing with cost-based pricing. The complexity of these SaaS solutions and the requirements for reliability and security means the associated costs might be quite high. Therefore, it is essential for companies with this type of pricing to ensure that revenue from a reasonably limited number of customers with high charges per account will cover these costs. Most of the pricing-related processes

are not formalized, pricing contract terms are discussed individually with all customers, and the required supplementary services define the final price to a large extent. Pricing information is not publicly available.

The literature discusses and proposes many factors that should be considered while designing and implementing pricing. As part of the multivocal study, we revealed 24 factors and classified them into four categories: Market, Company, Consumers, Product [1]. However, the impact of these factors and the aspects of pricing they affect remained unclear. Factors 1–4 correspond with the most cited factors as specified in [1]. While Factors 1 and 2 have a direct match, Factors 3 and 4 can be considered subfactors of a broader factor “functions and features” in the Product category.

Besides these four factors, product/company maturity, cost structure, and type of solution might affect and explain pricing practices in SaaS companies. However, our qualitative analysis suggests that maturity and costs could explain pricing practices ex-post rather than define them ex-ante. These factors set certain constraints and limitations on companies and managers; however, various companies overcome these constraints and limitations differently. As for the type of the solution, it was not clear how this could be determined and generalized from the case study as we covered only several categories of SaaS solutions from the extensive hierarchy (i.e., G2 software category hierarchy²). As a result, we decided not to incorporate these three factors in the typology.

5 Discussion and Practical Implications

The results of our study contribute to the understanding of pricing practices. We aimed to answer the research question of what types of SaaS pricing practices can be identified in a real-life context. To answer this question, we adopted a case-study research approach to explore pricing in fifteen SaaS companies. As a result, we developed a taxonomy of pricing practices. This typology can serve as a foundation for designing and establishing pricing practices in SaaS companies.

Our findings suggest that major factors of pricing in SaaS companies are the following: the targeted types of customers and market segments, the perceived value and willingness to pay for the SaaS solution, the complexity of the SaaS solution and its adoption by customers, and the level of nicheness of the SaaS solution. While the typology was based on an assessment of SaaS pricing practices, it can also be interpreted from the perspective of SaaS companies’ business models.

Several implications for SaaS companies can be derived from our study. Gaining a clear understanding of pricing complexity for a given SaaS business model is essential to its long-term viability. While certain types of SaaS pricing practices can be identified, there is still no silver bullet. Within each recognized type, practices may vary depending on many different factors (i.e., product/company maturity) and circumstances (i.e., regulatory constraints). Constant evolution and analytical-based experimentation with pricing might help to find the unique combination of pricing parameters that will allow the company to reach its objectives and ensure its long-term market success.

The findings should be considered in light of limitations that may have an impact on generalizability. Our sample of SaaS companies was reasonably limited and not

² <https://www.g2.com/categories>.

randomly selected. Within our study, we felt that we reached a saturation point where the same patterns started recurring, and no new insights were obtained by performing additional interviews. We included several secondary cases to have large, mostly B2C SaaS companies in our sample for analysis. However, a more extensive and more diverse selection of cases may have yielded different findings.

Although this study provides valuable insights into SaaS pricing, we call for further research probing the question of designing and implementing SaaS pricing. Our qualitative study offered a taxonomy of SaaS pricing, but its generalizability is limited. With our previous industry survey [12], this study provides some solid ground for further research that could employ quantitative analyses based on a large industry survey.

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