SMEs Playing in the Big Advertising League: The Transformative Potential of Programmatic Advertising and the Barriers to Its Full-Scale Implementation

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Abstract. Programmatic advertising has emerged as a transformative digital marketing tool offering precise audience targeting, scalability, efficiency, and resource optimization through advanced technologies such individual targeting options, optimized display-ad distribution, and real-time bidding. While large corporations have widely adopted programmatic advertising, SMEs face challenges such as technical complexity, high costs, lack of expertise, and GDPR compliance. Programmatic advertising offers SMEs opportunities to optimize budget allocation and enhance advertising efficiency, yet adoption barriers including transparency concerns, infrastructure demands, and workforce limitations persist.

Drawing from a synthesis of academic literature, industry reports, and direct insights from industry professionals, including marketing and advertising decision-makers from SMEs as well as high-level agency executives, we highlight both the benefits and challenges of PA adoption for European SMEs.

A Four-Phase Framework is proposed to guide SMEs through analysis, planning, execution, and evaluation of programmatic advertising, emphasizing gradual adoption, investment on technical infrastructure, and workforce training. Overcoming operational and regulatory hurdles is essential to unlocking PA's full benefits and ensuring sustainable competitiveness in the evolving digital advertising landscape.

Keywords: Programmatic Advertising · GDPR Compliance · Resource Constraints · Technological Infrastructure · Germany · SMEs

1 Introduction

Programmatic advertising (PA), the automated, data-driven ad buying and placement, has fundamentally reshaped digital marketing; so much so that it has been described as a cornerstone of contemporary marketing strategies [1]. Indeed, since 2023 PA constitutes over half of all non-social display advertising expenditures, with a total value

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of €96.6 billion [2] and has expanded beyond desktop platforms to mobile, video, and other digital channels [3, 4]. Its success rests on its ability to process advertising transactions within milliseconds, enabling advertisers to adapt swiftly to evolving consumer preferences and behaviors. This rapid functionality is supported by centralized data systems and algorithms capable of analyzing vast amounts of digital signals, including user demographics, interests, and online behaviors, to identify and engage relevant audiences [5–8].

By seamlessly integrating advertisers, publishers, and advanced technologies, including artificial intelligence (AI), machine learning, and Real-Time Bidding (RTB), PA facilitates the streamlined interaction between the buy-side and sell-side of digital advertising transactions [9, 10]. Moreover, by dynamically adjusting ad placement based on user behavior and contextual factors it efficiently delivers precisely tailored messages to specifically targeted audiences at optimal times thus achieving superior campaign scalability and performance, optimized resource allocation, and maximized return on investment (ROI) [11–18].

The transformative potential of PA has been recognized for years now [3] but in academia, this constellation of technologies is still under-researched and disassociated with practice [19]. Moreover, what little the academic literature has to offer about PA [20, 21] is based on studies of large multinational corporations and US-based firms, thus dominated by industries reports and handbooks. In Europe, and in Germany in particular, however, the backbone of the economy is small and medium sized enterprises (SMEs) [22] the specific challenges of which are notably ignored in the PA literature [11–13, 21, 23, 24].

This chapter synthesizes insights from various sources academic, industry, anecdotal and experiential (Discussions and direct insights from marketing and advertising decision-makers in German SMEs, in the B2B and retail sectors as well as senior agency executives and account managers) into an outline and explanation of PA which is accessible to the average marketer and business manager or owner of an SME. As we both live, teach, and work in Europe, we obviously see things from a predominantly western perspective and an understanding of SMEs as relatively simple in structure, usually family or owner-managed companies with less than 250 employees. We place an emphasis on the German context not only for convenience but also because Germany is the largest EU economy but still typical of the structure of the whole common market which is dominated by small by international standards SMEs.

1.1 A Brief Note on the German Context

The introduction of PA into the German market has evolved over time. First movers included the Trade Desk, a California-based company, which began operations in 2013 and Gruner + Jahr's 2016 programmatic booking initiative [25]. PA has since become central to digital marketing in Germany, projected to account for nearly three quarters of advertising revenue by 2024, totaling approximately €4.4 billion [15, 26, 27]. The internet now leads German advertising sales, surpassing traditional media [28].

Germany's PA ecosystem is supported by institutions like the Interactive Advertising Bureau (IAB) and Bundesverband Digitale Wirtschaft (BVDW), which set standards and provide training. Key players include technology providers such as Microsoft, Adform,

and Google's DV360, publishers like Improve Digital and Magnite, and service providers like Tradedoubler and Xaxis. Data management platforms (DMPs) like eXelate and Microsoft Invest further enhance PA by leveraging first party data [29, 30]. Events like d3con drive collaboration, while growing digital competition underscores the need for German SMEs to engage in PA [31–34].

1.2 Aim and Objectives

The aim of this chapter is to explore PA in the context of European SMEs. The objectives are:

(a) To demystify PA by providing a structured and comprehensive overview of the technology with an emphasis on the components of the PA ecosystem and their operational roles.
(b) To assist the non-expert marketer in evaluating the relative merits of alternative buying methods, operational processes, with an emphasis on targeting options, and PA effectiveness measures by outlining simple and easily applicable criteria for selecting between alternatives and evaluating decision outcomes.
(c) To provide a practical framework and SME-targeted recommendations for adopting PA.

The chapter is organized in the logic of the objectives. First, it describes the elements of the PA ecosystem and how they work together, it explains the buying and operational process and presents the commonly used PA effectiveness metrics. Then it discusses the benefits, challenges, and barriers to PA implementation by SMEs. Finally, a four-phase framework for PA implementation is presented and analyzed.

2 The Programmatic Advertising Ecosystem

The PA ecosystem is a sophisticated, data-driven framework that automates the buying and selling of digital advertisements. This system revolves around two primary stakeholders: advertisers on the buy-side and publishers on the sell-side. These parties interact through a set of interdependent platforms and technologies designed to optimize the efficiency and effectiveness of ad transactions. Central to this ecosystem are Supply-Side Platforms (SSPs), Demand-Side Platforms (DSPs), Data Management Platforms (DMPs), Ad Servers, and Ad Exchanges, each playing a distinct role in facilitating the delivery of targeted advertisements [5–7]. These we briefly present.

2.1 Supply-Side Platforms

Supply-Side Platforms (SSPs) are integral to the sell-side of PA, enabling publishers to aggregate, manage, and sell advertising inventory to a wide array of potential buyers (Learn Ad Operations, 2024). By connecting publishers with multiple advertisers, SSPs function as central hubs for managing ad inventory across various channels, including

websites, mobile applications, and video platforms. SSPs employ programmatic technologies such as RTB to maximize revenue by allowing advertisers to compete for available ad space through automated auctions. This competitive process ensures publishers receive the highest possible price for their inventory.

Beyond revenue optimization, SSPs provide publishers with tools to control pricing, manage inventory access, and customize ad placement visibility. These capabilities empower publishers to maintain granular control over their inventory, ensuring alignment with branding and content strategies [6, 7, 35, 36]. Additionally, the centralized functionality of SSPs enhances operational efficiency by streamlining the traditionally labor-intensive processes of inventory management and ad sales. As a result, SSPs play a critical role in helping publishers maximize the value of their inventory while retaining control over the advertising ecosystem.

2.2 Demand-Side Platforms

On the buy-side, Demand-Side Platforms (DSPs) provide advertisers with tools to manage, purchase, and optimize digital advertising campaigns in real-time. These platforms aggregate ad inventory from multiple publishers and exchanges, offering advertisers a unified interface to define campaign parameters, allocate budgets, and establish targeting criteria. By automating the ad-buying process, DSPs enable advertisers to focus on strategic decision-making while the platform executes bidding and ad placements [12, 13, 37].

A key strength of DSPs lies in their ability to leverage data to refine ad targeting. By incorporating insights from audience demographics, behavioral patterns, location, and contextual data, DSPs allow advertisers to bid on impressions that align closely with their campaign objectives [7, 12, 13, 37]. Furthermore, real-time analytics provided by DSPs enable advertisers to monitor campaign performance and make data-driven adjustments, enhancing both efficiency and cost-effectiveness. Through advanced targeting algorithms and automated bidding processes, DSPs empower advertisers to maximize ROI while reaching highly relevant audiences with precision [38].

It is obvious that the key ingredient of the marvelous PA gateaux is data. Where it comes from, how it is stored and managed, who protects it and how, we explore in the following section.

2.3 Data Management Platforms

Data Management Platforms (DMPs) form the backbone of the PA ecosystem as they facilitate the collection, organization, and analysis of vast amounts of consumer data from various sources. They are centralized systems designed to perform accurate segmentation and customer profiling to facilitate targeting, and personalization of digital advertising and marketing campaigns. To achieve these, they often work in conjunction with DSPs and customer relationship management (CRM) systems [7, 12, 13].

DMPs function in four key stages:

1) Data collection: DMPs aggregate data from multiple sources such as website interactions, corporate social media accounts but also scraping of data from user and

competitor accounts, online ads performance metrics such as click-through rates, and CRM databases which include data related to online and offline purchases, customer complaints etc. The data they collect can be both structured (such as databases) and unstructured (such as text and images) and as diverse as demographics, biometrics collected from smart wearables devices, purchase history, devices used to access online content, and how often people vacuum or mop their floors using data from their robotic vacuum cleaners.

2) Data cleaning, organization and processing: The platforms classify data according to predetermined rules and impose structural patterns on the data. DMPs currently in operation have high degrees of autonomy and unprecedented, and ever-increasing, processing speed and ability to handle complex operations as the utilize artificial intelligence (AI) and machine learning. Thus, they can not only combine multiple data sets and identify patterns even in the most unstructured ones, but they can also predict customer behaviors with high levels of accuracy through data transformation, feature selection, statistical pattern evaluation and interpretation. DMPs can perform various data mining functions such as *inter alia*:
   a. Supervised learning: categorizing cases on the bases of already labelled data (e.g. male/female customers).
   b. Unsupervised learning: detecting underlying patters in unlabeled data (e.g. behavioral and values, attitudes, lifestyle (VALS) segmentation).
   c. Association Rules: discovering relationships in data as in people who buy a mouse are also buying mouse pads.
   d. Neural networks which simulate human information processing much like our brains.
3) Audience segmentation and insights: The data are contextualized and integrated into custom audience segments which are then used to design and execute personalized marketing and advertising campaigns.
4) Data activation: DMPs integrate with DSPs, SSPs, to execute PAcampaigns.

Examples of DMPs are Adobe Audience Manager™, Oracle BlueKai™, Nielsen Marketing Cloud™, and Google Audience Center™.

Data Sources

DMPs integrate data from multiple sources such as user interactions with a company's website or apps, customer interactions with partner organizations, and aggregated consumer data collected by external providers and offered for sale [6, 7, 12, 13, 39, 40]. Further to their source, the key differentiators between types of data are their availability and quality. These two characteristics are in an inverse relationship (diagrammatically presented in Figure 1 and discussed in detail below.

The three categories of data DMPs use, and the main considerations of their use are explained herewith:

(a) First-Party Data are collected directly by advertisers or publishers from their own audiences, often through their in-house CRM platforms. They include user information such as website visits, demographic details, purchase history, and behavioral patterns. First-party data is highly valued for its accuracy and relevance, as it directly reflects company – user real interactions. Their collection, storage, management and

Fig. 1. Schematic categorization of types of data used in PA. Source: authors' own work based on O'Hara, 2016 [40]

utilization, however, can be resource-intensive, requiring substantial investments to ensure data quality and security. Despite the costs, first-party data remains integral to precise ad targeting, fostering stronger connections between advertisers and their audiences [7, 13].

(b) Second-Party Data are obtained through partnerships between companies allowing access the each other's first-party data through DMPs. This allows businesses to enhance their targeting capabilities by leveraging insights from trusted partners, thus reducing reliance on third-party data providers, broadening audience reach, and improving ad placement accuracy whilst mitigating some of the privacy and quality concerns associated with third-party data sources [7, 13].

(c) Third-Party Data are collected by data brokers, specialized organizations who are external to the advertisers, and made available for purchase. They are broad datasets compiled from multiple sources which means that they are often of lower quality compared to firstor second-party data. Moreover, because of the increasing enforcement of data protection regulations, such as the General Data Protection Regulation (GDPR), third-party data carry additional privacy and legal risks, as well as significant ethical concerns [8, 39] which means that their use must be carefully managed.

The data pool, to which advertisers and agencies have access, enables them to create detailed customer and prospects profiles on which they base their targeting strategies [7, 12, 13, 37]. Thus, DMPs play a pivotal role in audience segmentation and modelling. These processes help advertisers identify and engage existing and potential customers which share common or similar characteristics. By analyzing user behavior, purchase history, and contextual factors, DMPs generate actionable insights that support more effective campaign decision-making [7, 41]. These insights are seamlessly integrated into DSPs, enhancing targeting parameters and improving campaign performance.

The above discussion makes accessing and utilizing data sources look like a straightforward process handled by tech giants on behalf of companies who reap the benefits of

21st Century consumers' addiction to selfies, stories, and indiscreetly sharing what they eat, buy, think, hate and love for the world to see [42–44]. Alas! It is not so simple for SMEs.

All that Data is Not Gold

There is a good reason why for decades business intelligence and, in particular, marketing data collection, management, and utilization using statistical, machine learning, and database management techniques has been described as 'data mining': You need to dig wide and deep, shift through ore, overburden, and tailings – that is garbage to the uninitiated – and process tons of materials to get a nugget of gold. Much as data is the cornerstone of PA, driving audience targeting, segmentation, and campaign optimization, a number of obstacles stand in the way of effectively leveraging data to access the full potential of the PA ecosystem. The smaller the organization, the larger the obstacles.

SMEs have relatively limited access to high-quality first-party datasets as their CRM systems are rarely fully deployed and automated. They usually participate in, small networks of associated businesses, and even when they have access to networks involving large and structured partners, they only have low levels of power within these networks and so find it hard to acquire second-party data. Good quality, reliable, and accurate third-party data is costly and so often beyond the means of SMEs with limited marketing budgets. Much like the old jokes about dogs chasing cars, even if an SMEs, somehow, gains access to a good data set, knowing what to do with it and how best to exploit it requires infrastructure which is costly and requires high levels of expertise to develop and utilize. For European SMEs, compliance with the strict EU data protection regulations, such as GDPR, adds further complexity and imposes the need for dedicated data management resources [9, 15, 17, 45–51]. The data-related challenges SMEs face in implementing PA programs are summarized in Table 1 alongside their description and impact on marketing operations.

The last of the data-related challenges which European SMEs face when using DMPs for PA is particularly important and requires further elaboration.

The Specifics of General Data Protection Regulation

Regulatory issues and data privacy concerns have ethical, legal, operational, marketing, and financial implications. Strict adherence to regulations which aim to ensure ethical handling of consumer data and safeguard the public's right to data privacy, such as GDPR, is an imperative of corporate citizenship [52–55] but also a barrier to PA implementation for SMEs, especially in the EU. Given the sensitivity of personal information, compliance with data management regulations is essential for maintaining consumer trust and avoiding legal consequences [39] which can have wide reaching and hard to bear financial and reputational consequences.

The most important, in terms of legal and operational burdens placed on businesses in the EU [56, 57], regulatory framework affecting PA is GDPR, a summary of the principles of which (based on Article 5.1 which outlines seven key data privacy principles [58] , is presented here:

1) Lawfulness, fairness, and transparency: To ensure legal compliance, it is crucial to identify valid grounds for processing personal data. The Common Information Security Control outlines six justifications:

Table 1. Data-related challenges of PA implementation by SMEs

Challenge	Description	Impact on Businesses
Access to data	Due to underdeveloped CRM, limited access to networks of associated businesses, and budget constraints, SMEs struggle to acquire extensive high-quality datasets	Inaccurate segmentation. Incorrectly targeted audiences. Ineffective personalization Insufficient campaign optimization potential
Data acquisition costs	Acquiring quality data from reliable sources is costly, often beyond the financial scope of an SME marketing budget	
Infrastructure	Robust data management requires high initial investment in technical infrastructure, high maintenance and running costs, and access to costly and often hard to find expertise	Inadequate data storage, management and analysis lead to poor or ineffective decision-support, resource wastage, and suboptimal ad placement Poor data storage and handling incurs legal penalties and added compliance and litigation costs
Compliance with evolving data privacy regulations	There is a marked shift away from third-party cookies which complicates ad personalization and restricts and strictly regulates retargeting	SMEs need to invest in costlier alternatives like first-party data and contextual targeting Data-compliant, privacy-friendly solutions require redeployment of limited resources and strategic realignment of marketing approaches to maintain both relevance and compliance

a. consent,
b. contract,
c. legal obligation,
d. vital interests,
e. public task, and
f. legitimate interests.

At least one must be present to meet GDPR requirements for lawful data processing.

2) Purpose limitations: Following this concept ensures data subjects understand why their data is collected and have reasonable expectations about its management. It also gives them control over future use and the choice to provide or withhold their information.

3) Data minimization: GDPR mandates companies to collect only the minimum data necessary for a specific purpose. It emphasizes relevance and necessity, prohibiting data collection without a clear purpose, though it allows data collection for known future needs.
4) Accuracy: Every reasonable step must be taken to ensure that personal data that are inaccurate, or out-of-date, or not strictly conforming to the purposes for which they are processed, are erased, or rectified without delay.
5) Storage limitation: GDPR mandates personal data to be kept only if necessary for the intended purpose. Companies must justify their retention periods as longer durations increase the risk of data becoming inaccurate or outdated.
6) Integrity and confidentiality: This principle covers both internet and physical security. GDPR mandates that only authorized personnel can access personal data and requires recovery measures in case data is leaked to unauthorized parties, lost, altered, or damaged.
7) Accountability: This GDPR requirement emphasizes personal responsibility in handling data and adherence to set criteria. Records and measures must demonstrate compliance, and in case of a breach, safeguards should show efforts to prevent or rectify it.

As GDPR requires explicit user consent for data processing and so it fundamentally alters earlier digital business models, such as the free-for-all digital marketing landscape of the 2000s, and fundamentally transforms PA into a complex and strictly delineated process. It mandates that businesses implement measures like privacy notices, consent management platforms (CMPs), and data anonymization [59, 60]. Implementing its principles, such as the principle of data minimization, complicate the process of finding the balance between effective advertising and fulfilling privacy obligations [61]. Frameworks like the IAB´s 'Europe Transparency and Consent Framework' offer guidance but face limitations and legal challenges, adding uncertainty [62, 63]. Non-compliance risks penalties of up to 4% of global annual turnover, further pressuring companies to adapt PA [64].

Additionally, GDPR has accelerated the decline of third-party cookies, which had been the bread and butter of PA, forcing businesses to invest in first-party data strategies to maintain competitive capabilities [10, 65]. These efforts are essential for aligning PA practices with ethical and legal standards, but they demand significant investment and a focus on building and systematically maintaining user trust through transparency and explicit consent [39, 66]. The expansion of data-driven advertising practices is unlikely to be halted or reversed. It seems that its advance, however, will place ever more pressure on companies to strengthen and expand their legal resources to be able to effectively manage compliance in areas like user consent and data processing [67, 68]. For the German small marketing agencies, we interviewed the regulatory environment makes programmatic advertising difficult to implement due to the high initial costs setting up a compliance system requires. One of them characteristically noted that if there ever is an end to cookies from third-party providers, PA in its current form will naturally also come to an end.

It is clear from the above discussion of data-related issues that balancing datadriven PA precision with ethical and regulatory considerations is part and parcel of the DMP

function. Employing the services of DMPs which are not only reliable but also fully compliant with EU regulations enables advertisers to achieve their objectives whilst fending off the moral, legal, financial, and reputational risks incurred by being caught, or being perceived to be, in violation of regulatory standards. The ethical and safe approach to PA necessitates costly investments in compliance measures, IT systems, tech personnel salaries, and lawyers' fees, which often sum up to way beyond what an SME can comfortably afford. Challenging as responsible data management and compliance with privacy regulations might prove for advertisers, they, nevertheless, promote transparency and increase trust in the advertisers and the advertising industry. This way they ultimately benefit the digital advertising ecosystem and its users in the long term [69].

2.4 Ad Servers and Ad Exchanges

Ad Servers and Ad Exchanges (AdX) comprise the technical and transactional infrastructure of PA. Ad servers manage the storage, delivery, and tracking of advertisements, ensuring they are displayed to the intended audience. These platforms collect performance metrics such as impressions, clicks, and conversions, which are crucial for evaluating campaign effectiveness and implementing data-driven optimizations. The data gathered by ad servers often integrates with DMPs, enhancing the accuracy of targeting strategies [7, 12, 13, 37].

In contrast, ad exchanges operate as digital marketplaces where SSPs and DSPs facilitate the real-time buying and selling of ad inventory. These exchanges enable publishers to offer their inventory to a broad network of potential buyers, while advertisers can dynamically bid on impressions that meet their targeting criteria. The integration of ad servers and DMPs within ad exchanges support seamless functionality, ensuring the scalability and precision of programmatic transactions [7]. Ad exchanges exemplify the collaborative nature of the PA ecosystem, bridging the gap between buy-side and sell-side stakeholders through sophisticated technology and automated processes.

All the components of the PA ecosystem (diagrammatically presented in Fig. 2) collectively support the design and implementation of efficient data-driven advertising strategies. Figure 2 illustrates the technical process and the relationships between advertisers (buy-side) and publishers (sell-side) as well as the roles of SSPs, DSPs, DMPs and AdXs. It is important to remember that the PA ecosystem is a highly interconnected network of platforms and technologies designed to simultaneously optimize the delivery and effectiveness of digital advertisements. Each component plays a distinct role in streamlining the ad-buying process, from inventory management and data analysis to real-time bidding and campaign optimization but they can only function when they are fully coordinated in real-time. SSPs enable publishers to maximize revenue and control inventory, while DSPs provide advertisers with the tools to target audiences with precision. DMPs underpin data-driven decision-making by integrating and analyzing consumer data, and ad servers and AdXs ensure the seamless execution of transactions and ad delivery.

The PA ecosystem is a dynamic and scalable system that empowers advertisers and publishers to achieve their goals in an increasingly complex digital landscape. Understanding these elements enables advertisers to make informed decisions, optimize reach,

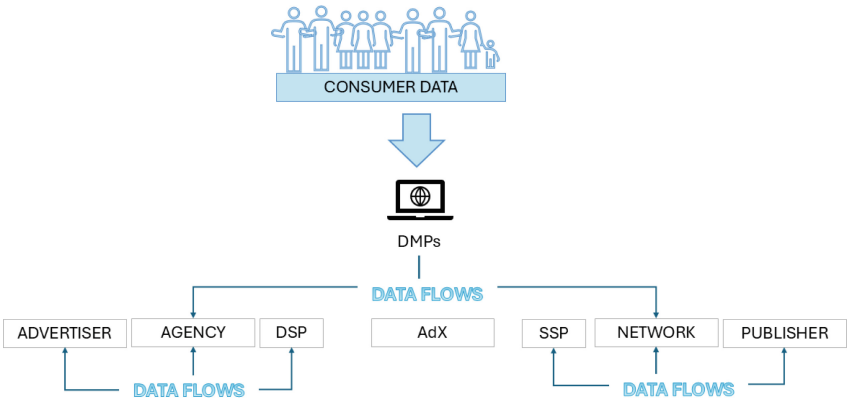

Fig. 2. Diagrammatic representation of the PA ecosystem. Source: authors' own work based on Bakare and Tolulope (2021) [70].

and ensure strategic placements while adhering to data privacy standards. Moreover, they need to be familiar with the technical process and buying methods of PA.

Building on existing insights [10, 13], highlights that the "black box" nature of programmatic advertising (PA) systems is exacerbated by staffing limitations. Interviewed business owners, CMOs, and online marketing managers from agencies and retail companies consistently cited a lack of technical expertise as a major challenge. Many described PA systems as opaque, leading to limited trust, particularly at the management level. Transparency concerns, coupled with the complexity of these systems, make internal operation difficult without specialized IT personnel. Moreover, many companies lack the technical maturity to successfully implement PA, often realizing too late that their internal capabilities are insufficient. This results in uncertainty regarding technical requirements and skepticism toward service providers and agencies.

3 Programmatic Advertising Buying Methods

Within the PA ecosystem, several technical processes govern the buying and selling of ad inventory, enabling the efficient execution of campaigns and optimizing ad placements to meet specific objectives. The key mechanisms of PA and their distinct advantages and tailoring potential to advertisers' and publishers' objectives (based on [11–13, 37] are presented here.

RTB is the prevalent form of PA. It enables advertisers to bid for ad impressions in real-time as users interact with websites. This automated auction system facilitates competition for ad placements, with the highest bidder securing the ad spot. Its scalability makes it highly effective for advertisers seeking to dynamically adjust bidding strategies based on current market demand and audience relevance. Transactions in RTB are facilitated through ad exchanges, which connect Demand-Side Platforms (DSPs) with Supply-Side Platforms (SSPs). Data Management Platforms (DMPs) and AdXs provide critical data and tracking support to enhance targeting precision as shown in Figure 2 [7, 11–13, 37]. RTB utilizes two primary auction models:

a) First-Price Auction during which the highest bidder pays the full amount of their bid, securing competitive, high-value placements. This model necessitates strategic bidding to manage costs effectively and avoid overspending.
b) Second-Price Auction, during which the highest bidder pays slightly more than the second-highest bid, fostering cost-effective bidding and encouraging broader market participation by reducing the risk of overpaying.

Both these auction models provide businesses with flexible, cost-efficient options for securing ad placements [7, 11–13, 37]. The PA ecosystem relies on both auction types and technical inventory purchase flow processes resulting in different transaction types. These processes coordinate the buying and selling mechanisms in specific configurations which align campaign objectives with the desired degree of control over ad placement and the available budget.

Purchasing ad inventory can take place using different auction or contractual arrangements, each offering varying levels of exclusivity, control, and pricing stability. As with all advertising decisions, the choice of PA transaction type is a function of campaign goals, budget, and brand safety requirement. The four primary methods are described and discussed based on a synthesis of academic and commercial and industry sources [7, 11–13, 17, 37, 71–73]:

(a) Open Auctions are the most accessible buying method within the programmatic ecosystem and the prevalent one due to its scalability and costefficiency. Publishers list their inventory on SSPs, allowing all connected advertisers to compete for ad impressions. Pricing is determined through competitive bidding, making this method highly scalable for advertisers seeking broad reach. Although Open Auctions offer limited control over placement, advertisers can employ blacklists to exclude undesired websites or environments, thereby ensuring a degree of brand safety.
(b) Private Auctions, also known as invitation-only auctions, provide a more controlled and selective approach to inventory sales. Publishers restrict access to a curated group of advertisers, offering security, exclusivity and enhanced control over ad placements. Conducted within Private Marketplaces (PMPs), these auctions prioritize brand safety and premium inventory, minimizing the risk of association with unsuitable content.
(c) Preferred Deals, also known as unreserved fixed rate, are non-auction-based arrangements where advertisers and publishers negotiate a fixed price for inventory. While inventory availability is not guaranteed, this method offers pricing stability and eliminates the uncertainties associated with fluctuating auction prices. Preferred Deals strike a balance between flexibility and predictability, making them suitable for advertisers who require cost consistency without fully committing to guaranteed inventory.
(d) Automated Guaranteed or programmatic direct, represents the most structured method of programmatic ad buying. In this model, advertisers and publishers directly negotiate both fixed pricing and guaranteed inventory delivery. Unlike auction-based methods, Automated Guaranteed automates the transaction process while ensuring access to premium inventory and guaranteed ad impressions. This approach is particularly advantageous for advertisers seeking high-value placements in prominent

digital environments, as it combines efficiency with reliability in delivery and brand visibility.

The PA inventory transactions follow a distinct sequence across Open Auctions, Private Auctions, Unreserved Fixed Rates, and Automated Guaranteed methods. The process begins with inventory made available by publishers on SSPs, where it is either open to all advertisers or restricted to a select few, depending on the chosen method. AdX and Ad-Servers facilitate these transactions by connecting DSPs and SSPs in real time, ensuring that each ad reaches its target audience effectively. These methods enable advertisers and publishers to optimize their approach based on campaign needs, choosing between highly competitive, flexible bidding options and more controlled, premium placements.

Each transaction method and data type in PA supports flexible options, such as Open Auctions for dynamic bidding or Programmatic Direct for guaranteed placements. Businesses can align these methods with their campaign goals to balance efficiency and control with data privacy and regulatory compliance restrictions and resource constraints, including the high costs of access to high-quality datasets [9, 45].

4 Programmatic Advertising Operational Process

PA follows the logic of traditional media planning and booking albeit transformed into a dynamic real-time process through automation and, data-driven decisionmaking [74]. Understanding this transformation process is crucial for advertisers and agencies both to fully harness the potential of PA to minimize ad spend waste and to accurately target predefined audiences [6, 7]. The PA ecosystem components such as data, targeting options, and real-time auctions are fully integrated but to make the process accessible to a general business and marketing audience we provide a breakdown illustrating how each element contributes to maximizing ad relevance and optimizing campaign resource use.

When a user lands on a webpage the publisher's ad server sends a signal to the SSP, indicating ad inventory availability. Advertisers, through DSPs, access this information and evaluate the available inventory based on audience profiles and bidding strategies that are optimized with first-, second-, and third-party data. This process triggers RTB, where the advertiser with the highest bid wins the ad placement. The banner for the winning ad is then transmitted to the publisher's ad server and displayed within milliseconds, ensuring that ads are bought and displayed at remarkable speed. This process is repeated with each page load, allowing advertisers to continuously optimize their campaigns based on user data and campaign performance [6, 7, 35, 75].

PA accommodates all the targeting methods used in traditional advertising but also introduces some new technology-based ones that ensure unprecedented levels of precision and relevance in ad delivery. The most common targeting options available within PA [7, 76–82] are presented in Table 2 which explains each targeting method and gives examples of their application possibilities.

Table 2. Targeting methods commonly used in PA

Targeting Method	Description	Example
Demographic	Advertising based on demographic characteristics like age, gender, income, etc	Targeting an audience aged 1835 with middle income
Geographic	Ads targeted by location, such as country, city, or region	Advertising for a store to users found within a 5 km radius
Behavioral	Advertising based on users' online behavior, such as visited sites or search queries	Targeting users who recently searched for travel to China
Contextual	Ads appear on websites relevant to the advertising message	A fitness ad on a sports website
Device	Advertising tailored to specific device types	Mobile-optimized ads displayed only on smartphones
Lookalike	Targeting audiences like existing customers	A face cream which is usually bought by middle-aged women is promoted to middle-aged women who have never bought it before
Re-Targeting (Remarketing)	Ads for users who have already interacted with a website or ad	Targeting a user who abandoned the shopping cart
Contextual Keyword	Ads appear on pages with specific keywords relevant to the target audience	Ads for travel insurance on pages with terms like 'vacation' or 'travel'
Interest and Life Stage	Ads based on users' interests or current life stages	Targeting users who recently became parents
Cross-Device	Targeting users across different websites and devices, understanding when a user is likely to switch between devices	Showing consistent ads to a user across their smartphone and laptop
Technical	Targeting based on technical as- pects like operating systems or device settings	Displaying specific ads for users on iOS devices
Semantic	Targeting by analyzing all visible text on a website to enhance ad relevance	Serving ads for eco-friendly products on pages where 'sustainability' is frequently mentioned

5 Programmatic Advertising Effectiveness Metrics

To assess how effectively a PA campaign attracts attention and fosters meaningful interactions it is essential to examine multiple core metrics which provide critical insights into both campaign performance and its optimization. Some of the key performance indicators (KPIs) used in PA are similar to what we use for traditional ad effectiveness measures whilst others are particular to the online environment and only available in the PA ecosystem. None of them is enough to evaluate a campaign on its own; instead, it is vital for designing efficient and cost-effective campaigns to examine a combination of KPIs. The most basic PA metrics help balance visibility with engagement to maximize results. Such KPIs are the following:

(a) Reach and Frequency are two KPIs which are usually examined together. Reach measures the number of unique users exposed to an ad, while Frequency tracks how often these users encounter the same advertisement. Together, these two metrics help advertisers balance widespread visibility with avoidance of overexposure which can lead to audience fatigue and diminished engagement [80, 83, 84].
(b) Viewability Rate measures the proportion of ads visible to users, serving as a benchmark for campaign transparency and effectiveness. In dynamic programmatic environments with diverse placements, achieving high viewability rates ensures ads are delivered as intended. Tools such as Google's Active View™ provide industry standards for optimizing viewability, thereby enhancing campaign credibility and impact [85, 86].

The purpose of an advertisement, however, is not to be viewed. The most commonly used KPIs which extend beyond basic impressions and provide nuanced insights into user behavior are the following:

(c) The most basic one is the Click-Through Rate (CTR) which measures the percentage of ad impressions that result in user clicks on the advertiser's website. This metric serves as a preliminary indicator of ad relevance and engagement. It highlights how well an ad resonates with its target audience but it is not sufficient for evaluating user intent or post-click behaviors [87]. It follows; all of us have, at some point in time, landed on a website we are not interested in by a careless mouse move. Moreover, users may click on an ad but disengage quickly, indicating limited interest or ineffective targeting. To decide which is the case we use complementary metrics, such as dwell time, bounce rates, and social interactions which offer a more comprehensive perspective by capturing post-click engagement.
(d) More nuanced than plain CTR is the Engagement Rate (ER). This metric reflects the breadth of interactions with ad content, encompassing video completions, social media shares, and interactions with dynamic elements like rich media. Particularly valuable for campaigns emphasizing brand storytelling or aimed at raising brand awareness, the engagement rate assesses both user interest and emotional connection [23, 38, 88–91]. Unlike CTR, which focuses on immediate clicks, the engagement rate metric reflects sustained and varied interactions, thus providing a more holistic understanding of user behavior.

Viewing an advertisement, visiting a website or even sharing an ad, however, does not translate to tangible marketing outcomes such as sales. To overcome this limitation CTR and ER are examined vis-a-vis outcome-based metrics which evaluate the degree to which a PA campaign drives desired user actions, such as purchases, subscriptions, or sign-ups. Metrics which bridge the gap between audience engagement and tangible business outcomes are the following:

(e) Conversion Rate (CVR) calculates the percentage of users who complete a specified action after interacting with an ad. As a direct measure of campaign effectiveness, CVR illustrates how programmatic strategies translate user interest into measurable results. For a complete interpretation of CVR analysts also take into account the segmentation criteria that were used as these significantly influence conversion behaviors [92–94].
(f) Cost Per Acquisition (CPA) measures the financial efficiency of an ad campaign by dividing total ad spend by the number of conversions achieved. This metric provides insights into the cost-effectiveness of customer acquisition efforts. For campaigns leveraging programmatic strategies, lower CPA values typically reflect effective audience targeting and budget optimization, both of which are critical for maximizing return on investment [38, 95, 96].

All the above KPIs are snapshots of a point in time. Advertisers, however, need to be able to assess the long-term effects of their efforts. Metrics which go beyond immediate ad or campaign performance or financial metrics to provide brand-related indications of the impact of PA are the following:

(g) Brand Recall and Brand Recognition evaluate the lasting impressions an advertisement makes. Because PA affords optimized frequency and targeting it is more likely to establish higher levels of recall and recognition, more durable brand connections, and better streamlined brand associations than traditional advertising [97–99].
(h) Neuromeric measure emotional engagement by employing sophisticated tools, such as eye-tracking, Facial Expression Analysis (FEA), and attention and emotional response analysis using voice, electrocardiogram, electrodermal activity, respiration, and other biometrics. Such technologies, which are used in laboratory settings but can also be used remotely, using web-based software and the users' laptop or mobile device webcam, provide detailed measurements of the users' cognitive and emotional reactions to advertisements. Such metrics can help refine the creative elements of a campaign in a way that amplifies emotional but also cognitive resonance [36, 100, 101]. As with all advertising efforts, financial metrics establish a direct relationship between advertising expenditure and revenue outcomes. The following metrics serve as essential tools for measuring profitability and supporting resource allocation decision-making.
(i) Return on Ad Spend (ROAS) quantifies the revenue generated per dollar spent on advertising. This makes it a key performance indicator (KPI) of financial efficiency. PA platforms use machine learning algorithms to optimize ROAS in real-time by reallocating budget resources to high-performing audience segments [38, 102]
(j) Cost Per Mille (CPM) calculates the cost per thousand impressions and is commonly used to assess financial efficiency in campaigns with broad awareness objectives.

While primarily associated with visibility-focused initiatives, CPM also holds relevance for performance-driven campaigns where reach supports conversions. By comparing CPM across platforms, advertisers can evaluate cost efficiency relative to audience reach [6, 7].

Finally, there is a need to track PA effectiveness throughout the consumer journey. The technologies employed in the PA ecosystem afford the data, computing power and advanced methodologies necessary to construct, track, and evaluate KPIs such as:

(k) Attribution Modelling which can be Multi-Touch Attribution (MTA), which allocates credit across various touchpoints in the customer journey to provide a comprehensive understanding of how different interactions contribute to conversions, or Last-Click Attribution (LCA) which assigns credit to the final interaction. Although easier to interpret and more cost-effective, LCA can result in underestimating the role of earlier touchpoints in driving brand awareness or behavioral intent. Selecting the most appropriate attribution model is critical for aligning measurement techniques with campaign objectives [103–105].

(l) Incrementality Testing evaluates the impact of PA by comparing outcomes between users exposed to ads and a control group not exposed. Incrementality testing isolates the advertising effect from organic behaviors, thus providing a clear assessment of the true value of the PA campaign [106, 107]. For advertisers with limited budgets, this approach ensures resources are allocated to strategies that demonstrably drive incremental results.

It is obvious that these KPIs are but tools which can be used to balance PA reach, visibility, cost, and efficacy. Some are simple to construct and interpret, others are more sophisticated and robust measures of the overall value of the advertising effort of the organization. To get a clear picture, a combination of these approaches needs to be employed as part of the strategic decision-making process for long-term marketing success.

6 To PA or Not to PA? That is the Question for SMEs

It is obvious from the above presentation of PA that employing it is not a simple, straightforward, intuitive process which is accessible to anyone with a basic business and marketing skillset. It is not at all like traditional ad buying, where the advertiser and the agency feel in control of a process they have used and seen being used numerous times. The speed and level of automation of PA can leave the advertiser feeling at a loss and wondering if they have made the right choices. Like with everything else in business decision-making, to choose between alternative paths you need to know how the different options work, their pros and cons, their benefits and potential pitfalls. Not many marketers and small business owners, however, can safely say they do know how PA works, how their data is being used and by whom, who gets paid and how, and how reliable the metrics they get from the platforms are. If you look at PA from the perspective of an SME it becomes obvious that, if anything, it is the benefits of PA which actually pose the most significant challenges of using it. We here present the issues German SME owners and marketing decision-makers identified as the key benefits and major hurdles in PA adoption and full exploitation alongside the relevant literature.

6.1 Benefits of PA for SMEs

Probably the most pressing problem for SMEs is to elaborate an appealing marketing message which cuts through the media clutter and gets across to those who need to receive it, at a time that matters to them. This is intensified by the fact that they have CRM systems which are either ad-hoc, or, usually, underdeveloped and lacking technological sophistication, limited advertising budgets, little or no in-house marketing expertise, and a size that precludes them becoming the clients of the big multinational advertising and digital marketing agencies.

The unparalleled targeting precision PA offers is the key reason for using it. Our informants, who were business owners, CMOs, and online marketing managers from both agencies and retail companies, highlighted the following advantages of Programmatic Advertising (PA) with respect to targeting:

a) Real time optimization of advertisements considerably improves targeting precision compared to traditional advertising or manually implementing digital advertising.
b) PA enables companies to specifically reach customers who are genuinely interested in their products thus reducing ad waste and improving ad efficiency.
c) PA increases reach without sacrificing targeting precision and efficiency.

Although not cheap, PA is perceived as cost effective provided sufficient financial resources are available. The key financial benefits they attributed to PA were the following:

d) Real-time control of budgets effectively reduces waste and eliminates overextending the pre-determined budget.
e) PA optimizes expenditures without sacrificing reach.
f) Automated adjustments save valuable time, particularly for companies lacking the capacity to manage campaigns manually.

An important issue that was raised by the executives and account managers of SMEs who are digital marketing and advertising agencies was the growth potential of PA, especially in view of emerging market trends and technological advancements. Key benefits they identified were the following:

g) AI-supported automation solutions such as ad creative tools, or applications which can perform automated A/B and playout testing, can be integrated into existing tools and techniques to create more appealing and highly personalized ads.
h) The increasing accessibility and transparency of PA and AI technologies could unlock significant market development opportunities through automated generation of ad creatives which could further streamline and optimize marketing processes.
i) Advances in artificial intelligence (AI), machine learning, and big data are fundamentally transforming the PA landscape, enabling greater targeting precision, more sophisticated audience segmentation, and real-time optimization, but, most importantly, they minimize the need for extensive human oversight, making PA both scalable and accessible to businesses of various sizes.

Finally, SME owners and managers as well as agency executives agreed that:

j) PA improves both the efficiency and the effectiveness of advertising efforts in the digital domain and complements rather than cannibalizes marketing communications, sales, and customer service in the physical domain creating a seamless phygital marketing environment.

6.2 Challenges and Barriers to PA Implementation by SMEs

Not all is rosy in the PA implementation arena for SMEs, however. We have already pointed out financial [11–13, 37], technological [1, 108], skills [38, 78, 109], and regulatory [67, 68] barriers through the literature review presented above. Germann SME owners and CMOs, and online marketing managers saw, more or less, the same issues standing in the way of their fully implementing the cutting-edge technologies available to them. As many SMEs perceive programmatic advertising as a 'black box' (see point 6.2.e), transparent and simple training measures (see Table 3, column 4) should be implemented.

The key financial challenges they identified were:

a) High setup costs and considerable internal effort required.
b) After running a few campaigns, it often becomes evident that achieving substantial results with limited budgets is challenging.
c) SMEs with limited budgets struggle to achieve adequate reach.

Many of the SME owners we talked to when writing this chapter described the systems as a "black box," the functioning of which they could not fully comprehend. The technology and skills gaps were seen as a single issue which, however, raised multifaceted concerns such as the following:

d) Business owners, CMOs, and online marketing managers from agencies and retail companies positioned the lack of technical expertise required to manage the PA system internally as the primary, if not insurmountable barrier and the cause for not reaping the benefits of digital technologies to the maximum. Indeed, programmatic advertising for SMEs.
e) Lack of technical expertise is associated with a perception of limited transparency of the PA ecosystem and its operation. SME managers who felt they lacked the knowledge to implement a PA system also highlighted transparency concerns as a key obstacle.
f) A perception of the firm as of low technological sophistication leads to limited trust in PA technologies, service and outsourced infrastructure providers and digital marketing and advertising agencies, particularly at the management level.
g) The complexity of the technical infrastructure required for PA was perceived as a significant challenge for firms who felt that operating such platforms would be nearly impossible without specialized IT personnel which they were worried would be hard to find or afford.
h) SMEs often have insufficient overall technical maturity.
i) SMEs who tried to their hand in PA soon found that they had overestimated their internal capabilities which proved inadequate for successfully implementing programmatic advertising in the long run.

j) There is often a lack of understanding of the technical and operational requirements of PA.

Finally, the evolving regulatory environment is seen as presenting SMEs which have some experience with PA and small agencies with a number of challenges such as:

k) GDPR complicates the effective use of PA.
l) There is a widespread fear of penalties in cases of non-compliance and many companies are concerned about potential legal consequences or find it too complex to use programmatic advertising in full compliance with data protection regulations.
m) The GDPR regulations regarding the phasing-out of third-party cookies present specific challenges for PA implementation and limit its efficiency in delivering personalized advertisements.

As SMEs face high setup costs when implementing PA, making it difficult to achieve sufficient reach (Challenge 6.2.b). This financial constraint for instance is addressed in Table 3 (Recommendation 2), which suggests leveraging funding options and strategic budget allocation to optimize resources. Similarly, compliance with GDPR (Challenge 6.2.k) is a barrier that Table 3 (Recommendation 1) addresses by recommending a cost-effective data protection strategy.

Dilemmas are oversimplifications of the lived reality of businesses, especially of the pressing conditions faced by SMEs who have to compete with MNCs and large corporations in the digital domain and even in their immediate physical neighborhood. Moreover, technological progress is non-reversable, so, sooner or later, even the smallest companies will have to find their way in the complex technological domain of business automation. So, the real question is not to PA or not to PA but how to reap the significant benefits enjoyed by the larger competitors. To this end, we propose the following Four-Phase Framework for PA Implementation.

7 Four-Phase Framework for PA Implementation

PA implementation can be developed in four phases which are distinct but interrelated and work in a virtuous cycle manner of analysis-planning-implementation-evaluationanalysis, etc. Each phase has a specific objective which is met by completing a set of actions. We also offer some actionable recommendations for steps to take and resources to utilize.

7.1 Phase 1: Analysis

Objective: To assess organizational readiness and prerequisites. The related actions involve resource assessment, market analysis, and regulatory compliance assessment.

The **resource assessment** step involves the evaluation of technical infrastructure and. Staff expertise using tools such as resource checklists or diagnostic software and setting a budget. The outcome of the resource assessment process is a comprehensive identification of strengths, areas for improvement, and functions which should be outsourced. **Market analysis** involves competitor and target audience analysis to define target audiences and preferred advertising channels. **Regulatory compliance assessment**

is needed to ensure that all data collection and management processes and infrastructure components adhere to data protection regulation such as GDPR. It is likely that at this phase, SMEs will need to seek external expertise if internal resources are insufficient. In this phase, we recommend the following practical steps and resources:

- Use free analytics tools
  - Google Analytics™, Meta Business Suite™ for audience insights.
  - SimilarWeb™ (free version) for competitor research.
- Check Regulatory compliance with minimal cost
  - Assess GDPR compliance using checklists from local business chambers.
  - Consult IHK or GDPR specialists for basic data compliance checks
  - Test free Consent Management Platforms (CMPs) such as OneTrust™
- Start with a small feasibility test:
  - Allocate €500–€1,000 to a low-risk test campaign.
  - Use retargeting ads to target existing customers first.

7.2 Phase 2: Planning

Objective: To develop a strategy and allocate resources. This involves three sets of interrelated actions which are very similar to all advertising campaign design and planning. A measurable use case should be selected as a pilot project. For example, a local retailer might choose to promote seasonal discounts via a PA strictly localized regional campaign. **Pilot project design** should be kept simple. **Budgeting and scheduling** involve establishing a clear timeline and allocating resources. It is recommended that between 10 and 20% of the annual marketing budget is allocated to PA testing. For the pilot PA project small budgets can be allocated to Google Display Ads™ or Meta Ads™. It is recommended that only one or two key segments (e.g., existing customers and lookalike audiences are targeted. **Technology and partner selection** require the evaluation of alternative PA platforms (e.g., Google Ads™, or Trade Desk™) or external full-service providers based on expertise, user-friendliness, cost, and suitability for the specific test campaign. In this phase, we recommend the following practical steps and resources:

- Leverage automated bidding strategies for better budget control.
- Outsource instead of building an in-house PA team

  Hire freelancers on Upwork or Fiverr for initial PA campaign setup.
  Work with a small digital agency on a single ad goal before committing long-term.
- Set realistic performance benchmarks
  - Aim for at least a 3% CTR and 1% conversion rate.
  - Compare PA results against existing Google or social ad performance.

7.3 Phase 3: Implementation

Objective: To execute the pilot project and gather insights. This phase comprises the following tasks:

1. Employee training through online modules or workshops
2. Pilot launch which involves the execution of the campaign as planned and the monitoring of its chosen performance metrics (e.g. click-through or conversion rates
3. Real-time adjustments to optimize the campaign based on collected data such as modifying audience targeting or content strategies.

For companies without an in-house digital marketing team the same steps are carried out with the assistance of a specialized, preferably boutique agency or freelancer. In this phase, we recommend the following practical steps and resources:

- Use cost-efficient automation tools:
  - Google Ads Smart Bidding™ for automated bid management.
  - Canva™ or Creatopy™ for affordable ad creatives.
- Use simple tracking methods instead of expensive DMPs:
  - Set up Google Tag Manager™ (free and easy for SMEs).
  - Leverage first-party data by growing a newsletter database.
- Opt for budget-friendly DSP alternatives. Instead of Google DV360, SMEs can use:
  - The Trade Desk Express™ (SME-friendly)
  - StackAdapt™ for small-budget display ads

7.4 Phase 4: Evaluation

Objective: To assess the pilot PA project success and decide on scaling. To harness the data required for informed and rational decision making on PA adoption, SMEs need to carry out **performance analysis**, which involves evaluating KPIs, including ROI and cost per lead and conversion using reporting dashboards, and maintain full **documentation** of successes, challenges, and lessons learned for future campaigns. On the basis of these, they are called to make **scaling decisions** aiming to gradually expand PA activities based on pilot outcomes and the integrate of the test PA findings into the long-term marketing strategies. To meet the evaluation phase objectives we recommend:

- Using simple KPI dashboards (e.g. Google Looker Studio™) to visualize performance data.
- Adopt simple, meaningful KPIs instead of complex analytics
  - Focus on CTR (Click-Through Rate) and Conversions.
  - Ensure cost per acquisition (CPA) is no more than 20–30% of product value.

- Only scale if ROI is positive.
  - If CPA is lower than the expected customer lifetime value (CLV) double the budget.
  - If CPA is too high, pause and optimize before reinvesting.
- Train internal teams using cost-free PA learning tools
  - Use Google Skillshop™ & Meta Blueprint™.
- Provide basic PA training for key employees before expanding efforts. Moreover, based on the analysis of the literature and the observations of the key barriers to PA adoption SME owners and managers shared with us we offer the following

Targeted recommendations for facilitating PA adoption and present their rationale in Table 3.

Table 3. Targeted recommendations for facilitating PA adoption by SMEs

Challenge	Recommendation	Rationale	Reference to 6.2
Technical infrastructure and data protection	Establish a robust IT infrastructure with a data protection management system to ensure GDPR compliance. Appoint a Data Protection Officer (DPO) or collaborate with specialized providers for data governance	Addressing data protection challenges builds customer trust and reduces compliance risks	6.2.k, 6.2.l, 6.2.m – GDPR requirements complicate data use and add compliance risks
Budget allocation and resource planning	Develop long-term budget strategies, leveraging grants or partnerships with advertising platforms to optimize resource use	Financial constraints hinder adoption. Strategic investments in automation and efficient tools lower operational costs and enhance campaign performance	6.2.a, 6.2.b, 6.2.c – High setup costs, difficulty in achieving sufficient reach with limited budgets
Workforce development and training	Provide specialized training to staff on PA technologies and outsource complex tasks to expert marketing agencies as needed	Addressing skill gaps accelerates adoption and improves outcomes, mitigating the challenge of limited internal expertise	6.2.d, 6.2.e, 6.2.f, 6.2.g, 6.2.h, 6.2.i, 6.2.j – Lack of technical expertise, per opacity of PA, limited trust in service providers
Marketing strategy and positioning	Develop an integrated marketing roadmap that combines datadriven advertising with clear branding strategies	Precise targeting through data-driven techniques, coupled with strong branding, enhances market competi-tiveness	6.2.d, 6.2.g, 6.2.j – SMEs lack technical maturity and a clear understanding of PA requirements
Technology adoption and innovation management	Conduct pilot campaigns to test PA systems on a smaller scale and collaborate with technology providers for efficient implementation	Gradual adoption reduces risk and fosters suc integration of innovative solutions	6.2.h, 6.2.i, 6.2.j – SMEs struggle with overestimating internal capabilities and technical challenges

8 Conclusion

Advances in artificial intelligence (AI), machine learning, and big data are fundamentally transforming the programmatic advertising (PA) landscape, enabling greater targeting precision, more sophisticated audience segmentation, and real-time optimization. Most importantly, these technologies reduce the need for extensive human oversight, making PA both scalable and accessible to businesses of various sizes [3, 110]. As AI-driven automation continues to evolve, PA is becoming increasingly efficient and cost-effective, offering advertisers the ability to optimize campaigns dynamically and personalize engagement at an unprecedented scale.

Beyond its current capabilities, PA is expanding into emerging channels such as programmatic television, audio advertisements, and immersive media formats. These developments create new opportunities for businesses to engage consumers in more interactive and personalized ways. For instance, programmatic TV allows advertisers to deliver targeted messages to specific households, while digital-out-of-home (DOOH) advertising leverages real-time data to enhance audience engagement. Furthermore, augmented reality (AR) and virtual reality (VR) technologies introduce immersive advertising experiences that captivate consumers and foster brand loyalty [8, 111]. These advancements underscore PA's ability to meet growing consumer expectations for relevant and engaging ad content.

Despite its transformative potential, the adoption of PA - particularly among small and medium-sized enterprises (SMEs) - remains hindered by challenges such as high setup costs, technical complexities, and regulatory compliance requirements. However, these barriers are surmountable with strategic investments in infrastructure, workforce development, and ethical data management. Implementing structured adoption frameworks, such as the Four-Phase Framework proposed in this chapter, can help businesses effectively navigate the complexities of PA while maximizing its benefits. As the regulatory landscape continues to evolve, particularly in the areas of data privacy and consumer protection, businesses must prioritize compliance while maintaining agility in adopting new marketing technologies. The shift toward first-party data strategies and ethical data practices will be crucial in fostering consumer trust and ensuring long-term sustainability.

Future research should explore tailored strategies for businesses, focusing on first-party data utilization, ethical data management, and innovative targeting methods. Longitudinal studies on PA's impact on competitiveness and sustainability would offer valuable insights for academics and practitioners alike. By addressing these challenges and capitalizing on emerging opportunities, businesses can position PA as a pivotal driver of digital transformation, ensuring resilience and success in a datadriven marketplace.

Appendix: Key Terms of Programmatic Advertising

An overview of the key PA terms with their definition and notes on each one's purpose, importance and key metrics is presented below to further support SMEs in effective decision-making towards implementing cost-effective PA strategies.

Term	Definition	Purpose, Importance and Key Metrics
(Ad) Impression	Counting an ad display to a user, a basic metric for measuring ad views	Indicates the ad's relevance and engagement with the target audience, as a high CTR suggests strong alignment between the ad content and user interests. CTR is essential for assessing the appeal of ad creative and messaging
(Ad) Inventory	Ad spaces available on publishers' websites for purchase via programmatic channels	Measures the effectiveness of the ad in driving meaningful user actions, such as purchases or subscriptions, after clicking. A high conversion rate indicates that the ad resonates strongly and drives tangible business outcomes
Ad Exchange	Marketplace for exchanging ad placements between buyers and sellers	Supports budget management and efficiency by tracking the cost per indi click, enabling advertisers to monitor ad spend and optimize costeffectiveness in engaging potential customers
Advertisers	Marketers who purchase ad placements to reach target audiences	A valuable metric to evaluate the financial efficiency of ad exposure by measuring the cost per thousand impressions, indicating how much is spent to reach a broader audience with targeted messaging
Audience Reach	Number of unique viewers who saw the ad, measuring reach and targeting effectiveness	Directly assesses the campaign's financial efficiency by evaluating the revenue generated for each dollar spent on advertising, guiding budget allocation based on return on investment
Click-Through Rate (CTR)	Percentage of ad clicks in relation to its impressions	Essential for determining the quality of impressions in programmatic platforms by measuring the percentage of ads that were actually viewable to users, thus ensuring ads reach users effectively

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Term	Definition	Purpose, Importance and Key Metrics
Conversion Rate (CVR)	Proportion of users who complete a desired action (e.g., purchase) after clicking on the ad	Tracks deeper levels of user interaction, such as shares, video plays, or social engagements, providing insights into user interest and engagement beyond mere clicks, valuable in awareness oriented campaigns
Cookies	Small files stored on a user's computer that record information about previous website visits	Measures the scope of unique users exposed to an ad, serving as an indicator of reach and ensuring that ads are successfully delivered to the intended demographic or psychographic audience
Cost Per Acquisition (CPA)	Cost of acquiring a customer or a specific action, essential for budget allocation	Ensures the ad maintains visibility without causing user fatigue by measuring the frequency of ad exposure to the same user, supporting a balanced approach between brand visibility and user experience
Cost Per Click (CPC)	Cost per ad click, used for budget management and cost-efficiency analysis	Helps in understanding the acquisition costs for each customer or targeted action, allowing advertisers to manage budgets more effectively and focus on strategies that yield cost-efficient customer acquisition
Cost Per Mille (CPM)	Cost per thousand impressions, measuring advertiser cost for ad reach and visibility	Increases the efficiency of digital campaigns by automating the process of media buying, enabling precise targeting, and optimizing ad placements in real-time, which enhances reach and budget effectiveness

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Term	Definition	Purpose, Importance and Key Metrics
Data Management Platform (DMP)	Platforms supporting DSPs with data acquisition and targeting enhancement	Facilitates precise ad placement to target audiences by enabling advertisers to bid for impressions in real-time auctions, increasing the likelihood of engaging relevant users with tailored ads
Demand Side Platform (DSP)	Platforms assisting advertisers in selecting and purchasing impressions	Provides a fundamental metric to count ad exposures to users, serving as the baseline for assessing overall campaign reach and tracking the visibility of the advertisement
Display Advertising	Online advertising, mainly in banner form, delivering marketing messages to website visitors	Defines the available ad spaces on publishers' platforms, representing the inventory that can be programmatically acquired by advertisers for efficient ad placement
Engagement Rate	Metrics that measure user interactions (e.g., shares, video views), crucial for awareness campaigns	Aims to communicate targeted messages to web visitors by displaying banner ads, which can drive awareness and brand recall among users browsing digital spaces
Frequency	Number of exposures of the same ad to the same user within a given period, preventing oversaturation	Blends into the visual format of the hosting platform, offering a seamless and less intrusive experience for users and enhancing the likelihood of engagement by matching platform aesthetics
Publishers	Operators of websites providing ad spaces for advertisers	Assists advertisers in streamlining the ad placement process by selecting and purchasing the best-suited impressions, which optimizes targeting precision and budget efficiency

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Term	Definition	Purpose, Importance and Key Metrics
Real-Time Bidding (RTB)	Process to deliver ads to targeted audiences through real-time auctions	Helps publishers effectively manage their ad spaces, maximizing ad revenue while ensuring suitable ads are displayed to users in alignment with publisher and audience interests
Retargeting	Repeated advertisement exposure for users who previously interacted with similar content	Facilitates an automated and streamlined transaction process for ad placements, allowing real-time bidding for efficient exchange between buyers and sellers in the advertising marketplace
Return on Ad Spend (ROAS)	Revenue generated relative to advertising spend, assessing financial efficiency	Enables DSPs to improve targeting capabilities by gathering and analyzing data from multiple sources, which assists advertisers in reaching audiences based on specific criteria
Supply Side Platform (SSP)	Platforms helping publishers manage and sell their ad spaces	Personalizes ad messages to appeal to users based on collected personal information, like demographics and purchase history, which enhances ad relevance and the likelihood of user engagement
Targeting	Targeted advertisements based on personal data, such as name, purchase history, demographics, and interests	Boosts conversion likelihood by re-engaging users who previously showed interest, using past browsing behaviors to display relevant ads that prompt continued interaction with the brand
Viewability Rate	Percentage of ads actually viewable to users, ensuring effective impressions	Allows collection of user behavior data to improve targeting and retargeting accuracy, facilitating better-tailored advertisements that align with user preferences and prior online activities

Source: [11, 13, 35, 74, 84, 86, 88, 94, 96, 97, 102, 104, 112–121]

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