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A Primer on Programmatic Advertising

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The Rise of Programmatic Advertising

In 2016, many industry observers believed that programmatic advertising—digital advertising allocated through automated marketing systems—was the future of digital advertising. It offered remarkable speed and sophistication. In a programmatic environment, in the .35 seconds it took for a user to click on a URL and the content to load, a breathtaking amount of activity took place. An algorithm evaluated an optimal bid for an advertiser, a real-time auction determined a winning bid, the winning ad was displayed, and the advertiser was notified that the ad had been viewed (see Exhibit 1).

In a programmatic advertising environment, buyers and sellers of online (digital) advertising connected over an exchange, buying and selling available inventory. The value of the automated system lay in the sophisticated technology and analytics that simultaneously supported and informed the exchange. For example, while data collection systems analyzed visitor behavior allowing for better targeting of the audiences, real-time bidding for inventory across multiple digital channels (mobile, display, video, social, etc.) provided instantaneous pricing and access. One media buying expert likened programmatic advertising to the financial markets: "Programmatic buying is similar to programmatic stock trading insofar as it happens as the result of a computational proxy bidding on behalf of human masters."[1]

Legendarily, digital advertising began 1994 with the first HotWired banner ad from AT&T, which prophetically asked: "Have you ever clicked your mouse right here? You will."[2] Until that time, online advertising had been merely an extension of traditional practices—from print to an electronic medium. "The same white table cloth lunches served to negotiate deals and the resulting insertion orders, more often than not, were sent via fax."[3] But that world changed rapidly as content exploded. In the 1990s, advertisers might have competed for space on a few hundred publishing sites offering digital content, but by 2012 the number of publishers had

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grown to millions. With that growth, a complex ecosystem developed to support and drive the business of digital marketing and ultimately programmatic advertising.

The explosion of digital advertising was a global phenomenon. In the United States, digital media was expected to represent 37% of total media spending in 2016.[4] At $72.09 billion, digital advertising was—for the first time—expected to exceed the media spending on television advertising ($71.29 billion) and was expected to continue to experience growth at a faster rate than television[5] (see Exhibit 2.)

The pattern of growth was also reflected globally with digital spending growing the most rapidly (16.1% increase) at over twice the rate of television (see Exhibit 3).

Fueled by penetration and reliance on smart phones, mobile ads were one of the fastest growing segments of digital spending.

[i] In 2016, mobile programmatic spending overtook desktop spending with mobile spending growing to $17.7 billion. EMarketer forecasted that mobile spending would account for about 70% of all programmatic ad spending, fueled both by display and video ad spending (see Exhibit 4). In addition to the ubiquity of mobile devices, they offered the ability to track location. Because the device was constantly traveling with the individual, advertisers could leverage location and context to obtain better information and targeting.

Yet for all its promise and results to date, there were challenges associated with mobile programmatic advertising. Programmatic advertising was based on data: for desktops and laptops, that data came from cookies; but mobile devices and their associated applications (apps) did not use cookies—data was delivered with unique device identifiers. The different forms of data were a challenge to the existing programmatic infrastructure, but it was expected that the obstacles would be overcome quickly given the potential for the segment.

THE PROMISE OF PROGRAMMATIC ADVERTISING

Currently one in four dollars of total media spending is spent on digital marketing.[6] Programmatic advertising leverages technology to automate and optimize the process of buying and selling digital advertising, often through a process of real-time bidding (RTB). To understand the promise of programmatic advertising, insight into the scale and scope of digital marketing is helpful. The major categories of digital advertising include the following:

- Search advertising made up nearly half of digital ad spending (non-mobile search advertising made up over one-third of the digital spending in 2015), and came in the form of text advertisements that appeared at the top and right-hand side of search engine results. Google and Bing were the key players in search marketing (see Exhibit 5).

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[i] The mobile segment captures all digital media delivered to the mobile platform including banner, digital video, rich media, etc.

- Display advertisements (text, static, or video) made up the remaining half of digital ad spending, and were shown across various publishers or websites online, including blogs, news websites, and video platforms (see Exhibit 5).
- Within the video category, Google's YouTube was the dominant player. Video advertising existed as pre-roll videos (typically in 15- or 30-second ad formats, reminiscent of a traditional television commercial), or a banner or text ad accompanying or appearing on top of a video as it played. Some publishers enabled consumers to skip ads after a few seconds. While perceived as consumer-friendly, it required the development of content that was immediately engaging so that the consumer would not choose to skip the ad.
- Rich media ads were typically animated, displaying moving images such as a character walking across a screen once the page was fully loaded. Some rich media ads encouraged active customer engagement with a brand by creating an interactive game that a consumer could play.

Unlike almost any other form of advertising, digital marketing created data, and advertising technology companies emerged to leverage it. For example, customers' visits to websites were tracked using cookies. If the customers did not initially purchase, the advertiser could present that same customer additional ads reminding or encouraging them to purchase. Online retailers tracked products that a customer reviewed and then retargeted that customer by displaying an ad for the product that had been under consideration. One observer noted:

> The world's digital ad markets already make available 100 billion impressions a day. Each of these impressions is qualified by as many as 100 variables, such as specific publisher sites, pages on site, dimensions of ad unit, device types, and so forth. In addition, each variable may have appended up to 100 different values, such as time of day, day of week, device location, local weather, regional sentiment, and so on.
>
> If you calculate the daily number of permutations bidders on ad exchanges might consider in analyzing whether to buy specific impressions, and calculating what to bid for each of them, the answer comes to a staggering 1 with 15 zeroes behind it. That's a quadrillion—a million billion possibilities.[7]

That complexity led to the rise of programmatic advertising. According to AdWeek, 55% of digital display ads were purchased programmatically, and in total 52% of non-search digital ad transactions were programmatic. Further, it was anticipated that by 2020 programmatic advertising could account for 85% of targeted banner ads and 67% of streaming video ads.[8]

For advertisers, programmatic marketing offered the promise of less costly and more targeted and effective placements. The challenge was often negotiating the ecosystem that supported programmatic advertising.

The Programmatic Advertising Ecosystem

The opportunity and growth of programmatic advertising gave rise to a complex system of providers that connected advertisers and publishers (see Exhibit 6). As the industry developed, companies entered and exited according to the direction of the industry. A brief overview of the process follows:

Ad Creation: Be it through programmatic advertising or any advertising media, the goal of all advertisers was to reach potential customers in a cost-effective way to influence or create purchase. In the programmatic space, while technology plays an enabling role, the first step is similar to traditional media spending—the advertiser works with a media agency to create a strategy, a campaign, and the ad. The agency may then work with other players in the ecosystem such as those in creative optimization to enhance the ad with rich media and allow for dynamic messaging. The creative optimization organizations support their ad by reporting key metrics including impressions and clicks.

Verification services vendors offer insight into performance with metrics that might include the percentage of ads displayed to the end user, the specific websites that the ad ran on, and whether the ad was placed next to questionable content. Functionally, this is accomplished by attaching a piece of code to the ad that records each time the ad is displayed, creating information not only on the current ad, but also providing insight into which publisher, network, or exchanges might work best for the next campaign.

Customer Targeting: Data management platforms (DMPs) purchase information (including geographic data, lifestyle preference, and shopping behavior) from data suppliers. The DMP acts as a warehouse—housing, packaging, and selling information to other players in the ecosystem. Players include publishers, advertisers, and other technology companies who use the information to target audiences and improve campaign performance.

Placement: Ad agencies place ads using its agency trading desk (ATD) and an ad server. ATDs are specialized buying groups within an advertising agency (for example, Xaxis with WPP, VivaKi with Publicis) using in-house proprietary technology or a demand-side platform (DSP). The ad server is the service responsible for placing the ad on the defined websites.

The DSP is an online platform where advertisers (or their agents) purchase inventory on connected ad exchanges, ad networks, or other available inventory sources. The DSP can also be used to collect data from third parties, often DMPs. The DSP will connect to ad exchanges where advertisers can bid on and auction available ad inventory in real time. If being used for RTB in ad placement, the DSP centralizes ad bidding and reporting into one interface. The ad agency could also choose to place the ad through an ad network that has prepurchased and aggregated inventory across multiple publishers—reselling it with a mark-up. Unlike the RTB process on the ad exchange, ad networks have fixed CPMs (cost per 1,000 impressions.) Ad networks can be vertical or horizontal. At premium prices, vertical networks are fully transparent regarding the inventory purchased and the sites on which it will be displayed. Horizontal networks offer more affordable pricing but do not offer full transparency—

typically running on prepurchased inventory as well as a mix of targeted sites that are bid from the ad exchange.

Publishers use a supply-side platform (SSP) to manage and sell their inventory on multiple ad exchanges and networks. In the SSP, publishers set the price and audience type for their inventory as base line metrics for the ad exchange. The role of the SSP is to optimize the selling price for the publisher, maintain the quality of the ads, and extend the buyer reach.

Buying and selling of ad inventory occurs on the ad exchange in a matter of milliseconds. Companies that own an extensive network of publishers have created their own exchanges where only inventory from their networks are available. Most often the methods of selling ads occurs with RTB. As the DSP accesses the available inventory on the exchange, the SSP provides the inventory available on the exchange. Ad exchanges can build scale by accessing multiple SSPs or by accessing one or many ad networks.

PROGRAMMATIC CHANNELS

While real time bidding is the mechanism most often associated with programmatic advertising, other types of structures have emerged to give advertisers greater control over where the ad is placed and its cost (see Exhibit 7). They include: [9]

Private Marketplaces (Closed Auctions/Invitation-Only Auctions): Publishers interact with a defined set of advertisers that meet predetermined criteria and provide exclusive inventory (premium inventory) to the group. The publisher extracts value depending on who bids the highest but still has no control over exactly how much the advertiser will pay. The benefit for the advertiser is insight into precisely where their ads will be placed.

Preferred Deals: The advertiser agrees to pay a fixed price for the inventory and the publisher gives the advertiser the first right of refusal before making the inventory available to others. With this structure, the publisher has more control over the quality of the ad as well as more control over the value because they know exactly with whom they have engaged and how much they will pay. If the advertiser chooses to exercise its refusal right, the publisher can send the inventory to a private marketplace or RTB to generate value.

Programmatic Direct (Programmatic Guaranteed or Automated Guaranteed): The publisher engages one-to-one with an advertiser and agrees to carve off a section of their inventory for them. The advertiser agrees to buy all of the inventory at a fixed price. No auction takes place and both parties agree that a transaction will take place at a given price. The "programmatic" component is merely the automation of the buying and the selling process. Otherwise it reflects the traditional "guaranteed" selling model.

Challenges of Efficiency and Effectiveness

Several key issues prevented digital advertising from being as effective as possible. Ad blocking was one of those issues. As consumers became more sophisticated and acclimated to the marketing technology, they began to dismiss ads, and many took action to prevent advertisers and publishers from serving them ads. Forrester (2013) "found that more than 27%

of computer users were using software such as AdBlock for blocking some ads and tracking cookies. But relatively few people block all cookies, and even those who block tracking may still get ads—just ones that are less relevant."[10]

Tracking customer behavior with ads was another challenge for marketers, particularly brands and advertisers looking to be as efficient as possible with their advertising dollars. Much of the current targeting capabilities were connected to some form of 'tracking cookies.' Cookies are ineffective in mobile advertising, making it difficult for marketers who want to run campaigns across mobile devices and desktop applications.[11] With the rise of mobile browsing, content consumption, and shopping, many customers might research and compare on one device, but ultimately purchase on another. It was not unusual for a customer to research a pair of shoes on her mobile phone on the subway ride to work, then do some comparison shopping on her desktop computer at the office, and later that night, ultimately make the actual purchase on a laptop computer at home. Advertisers, however, were improving tracking across the customer research cycles that led up to purchase. For instance, "Google's cross-device sync for its Chrome browser [made] it possible to retarget ads to the same person, assuming that the person is logged onto Chrome on each different device."[12]

Fraud was a third challenge for many players across the digital marketing value chain. Some experts estimated that nearly one fourth of all digital ad traffic is fraudulent, costing the industry $6 billion in digital ad revenue[13] (see Exhibit 8).

> One of the unpleasant realities of online advertising is that a lot of the traffic being paid for doesn't actually exist. It is fraudulent traffic, created by people who make money from machine-generated impressions and clicks. . . . Such traffic is generated by computers that have been infected by viruses and instructed to visit websites—usually without the computer owners' knowledge.[14]

Developments in machine-learning technologies, however, were becoming more effective in identifying fraudulent patterns and avoiding them. Further, advertisers were taking steps to reduce fraud by requesting more detailed information from their agencies and keeping 'black lists' of sites highly associated with fraud.[15]

The Future

The outlook for programmatic advertising was bright but there were challenges of growth and expansion. These included questions of operational optimization, the role of individual players—especially the ad agency in the programmatic ecosystem—and the further expansion into other formats such as television.

OPERATIONAL OPTIMIZATION

Good data and execution were the key drivers of programmatic advertising. As the industry moved further into the mobile space, it faced issues of data collection based on the space's different networks, form factors, device capabilities, and connectivity speeds. Further, targeting was challenged by the absence of standard 'cookie,' and the fragmentation of

suppliers and exchanges using different mechanisms. Much of the ecosystems for mobile were still under construction. As one observer noted, "Marketers are investing billions a year in mobile, yet continue to complain that they cannot accurately trace and measure their efforts, resulting in an inability to have a clear pictures of mobile's return on investment."[16]

As 2016 came to a close, questions of data integrity surfaced when Facebook announced issues with its metrics. In September, the company announced that it had been inflating its average video ad view time metric for about two years. In November, Facebook further announced that four additional metrics had been miscalculated, including the number of full video views, time spent on instant articles, and the monthly and weekly reach of marketers' posts. Analysis suggested that a metric measuring how many people can see a publisher's content on its page might be revised downward by 55%. "That disclosure prompted a flurry of discussion over whether publishers and advertisers could trust the data they were getting from one of the two dominant players in digital media."[17] Facebook's miscalculation of metrics ultimately resulted in calls for providing third-party auditors with greater access to Facebook's data.[18]

THE ROLE OF THE AD AGENCY

In the traditional advertising space, the large ad agencies had offered global scale and scope and provided turnkey offerings including advertising strategy, creative services, and placement. In the 'new world' of digital/programmatic advertising, their role and value add was less clear.

The world's largest ad agencies (e.g., WPP, Publicis, and Omnicom Group) had built significant programmatic advertising businesses. For example, WPP, the largest of the ad holdings companies, built its own programmatic trading operation, Xaxis, to compete against Google's DoubleClick. There, revenue grew 16% in 2015 and was projected to hit $1.1 billion in 2016.[19] WPP also planned to profit from its market research unit Kantar Group in addition to its ownership of GroupM, the world's largest media buyer (see Exhibit 9). One of WPP's strategic goals for 2016 was to "maintain the share of more measurable marketing services—such as data investment management and direct, digital, and interactive—at 50% of revenues, with a focus on the application of technology, data, and content."[20]

Programmatic advertising had been a source of growing disquiet between advertisers and their agencies primarily because of a lack of transparency in pricing (see Exhibit 10). One reporter noted:

> Growing unrest on Madison Avenue [is building] over the way some web ad agencies decline to tell their clients the original price of the web ad inventory they're buying. Agencies buy the media upfront with their own money. They then slice and dice it, according to data they've gathered themselves, making it more targetable and thus more valuable. The media is then sold at a premium to clients. Clients don't know what the original price was—and thus, nor do they know what the agency's markup is. Critics call this practice "arbitrage" or "frontrunning."[21]

Agencies note that they add value to the inventory with the application of their own analytics and data and assume the risk of not selling the data as clients aren't forced to purchase it.

In the 2016, the Association of National Advertisers (ANA) in the United States commissioned a study of advertising practices across all media including programmatic advertising.[ii] One of the issues under investigation was agency-paid 'kickbacks' in the form of volume rebates to media properties—that agency holding companies provided financial incentives for their agencies to direct spending to their ATDs. The scope of the ANA report covered both digital and non-digital channels but found some of the practices rooted in the programmatic ecosystem. A reviewer of the report noted:

> At their most straightforward, rebates are structured as cash paid to agencies by media suppliers as bonuses for high spending. But other structures have been employed as well, including consulting fees billed by agencies for offering overpriced services of little value. . . . [The report] found that with "principal transactions," where the holding company acts as a media supplier, media markups range from 30% to 90%.[22]

The lack of pricing transparency had resulted in some major advertisers (Procter & Gamble, Ford, Citibank, Unilever, Kimberly-Clark, Netflix, and AT&T) reducing their spending on programmatic advertising or moving their operations in-house. P&G went even further, announcing that 70% of its budget would be run programmatically through its own initiative Hawkeye. (Hawkeye had been established in 2010). In addition to avoiding agency fees, the other driver to move in-house was to have more control over their data. "Unilever credits its internal Ultra programmatic system with capping fraudulent ad impressions in the United States at 2%—an incredible number considering the industry average."[23]

In-house systems, however, require significant financial investment in not only the technology but also talent knowledge and experience in the programmatic ecosystem; talent that is in short-supply. Regardless of whether the activity was in-house, some industry observers believed the agency continued to play a pivotal role, noting:

> The creative work and strategic advice that digital agencies can provide is as important as ever, and in many cases agency-based technology solutions are a marketer's most compelling option. But ad tech, and the practices it enables, demand a different, more hands-on and data-rich partnership than was seen in the past. [24]

As programmatic advertising continued to grow and mature, agencies were in transition. For example, in 2015, Publicis Group broke up its stand-alone programmatic operation, VivaKi, and embedded its programmatic talent (120 people) within its established agency groups. The

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[ii] The study 'An Independent Study of Media Transparency in the U.S. Advertising Industry,' was prepared by K2 and published in June 2016. The methodology involved confidential interviews of 143 interviews from 150 different sources. At the time of the writing of this case, while the study was quoted frequently, it had not been accepted by the ad agencies.

move was seen as an attempt to integrate programmatic advertising into the core of the organization, and bring 'technology jockeys closer to its clients.' For some the move was an admission that the ATD no longer worked, noting, "Client 'trust issues' with their agencies' programmatic buying and billing practices had devolved to the point where many flatly refused to allow their agencies to buy from the sister trading units."[25]

TV: THE NEXT FRONTIER?

Many proponents of programmatic advertising believed that programmatic television would be the next extension of the media. In 2016, IDC forecasted $1 billion in advertising sold programmatically, as yet a small proportion of the $70 billion US market,[26] though eMarketer expected the share to increase to 13% by 2019.[27] Mondelez pioneered early stage programmatic television during the 2015 Super Bowl with 15-second spots for Oreo cookies and Ritz crackers shown only in a regional market of 100,000. While the ads were not purchased through RTB, an executive from Mondelez noted that it was the "future of automated TV buying."[28]

Typically, television advertising was sold during a period called 'upfronts' when networks (traditional and digital media companies) presented their new offerings and 'pitched' to advertisers for advertising dollars. Following that period, any unsold inventory was sold on a scatter market. Much of the processing is manual (RFPs, insertion orders, etc.) making it ripe for automation. The promise of programmatic advertising is to leverage the technical functionality of the set-top cable box to better identify customers and audiences, and then sell TV spots programmatically. While advertisers could target the audience, they had no control over where the ad played. Part of the question in creating scale for programmatic television advertising was quality inventory, with "most of the available inventory coming from local cable companies and satellite TV without national or prime-time" offerings. With a limited number of sellers and a lucrative existing business model for television advertising it was unclear when prime inventory would become available.[29]

Another way that programmatic television could influence the television space was through better targeting of ads using 'addressable TV.' For example, proponents argued that using the set-top box from cable operators, auto advertisers could deliver ads only to those customers likely to purchase a car. Traditional television ad purchasing was purchased directly from the broadcaster based on broad data (age and gender) generated from vendors such as Nielsen. With addressable TV, matches could be identified on a household level, bid in real time, and delivered to the targeted household. [30]

The other currently small, but potentially attractive segment was 'connected TV.' Using this model, advertising was delivered to TV apps (with ads within full episodes of television shows) or to the digital menus of individual apps. The explosion of Internet-based platforms such as Crackle, Roku, and Hulu made connected TV attractive, yet industry leaders such as Netflix and Amazon did not include advertising in their streaming models.

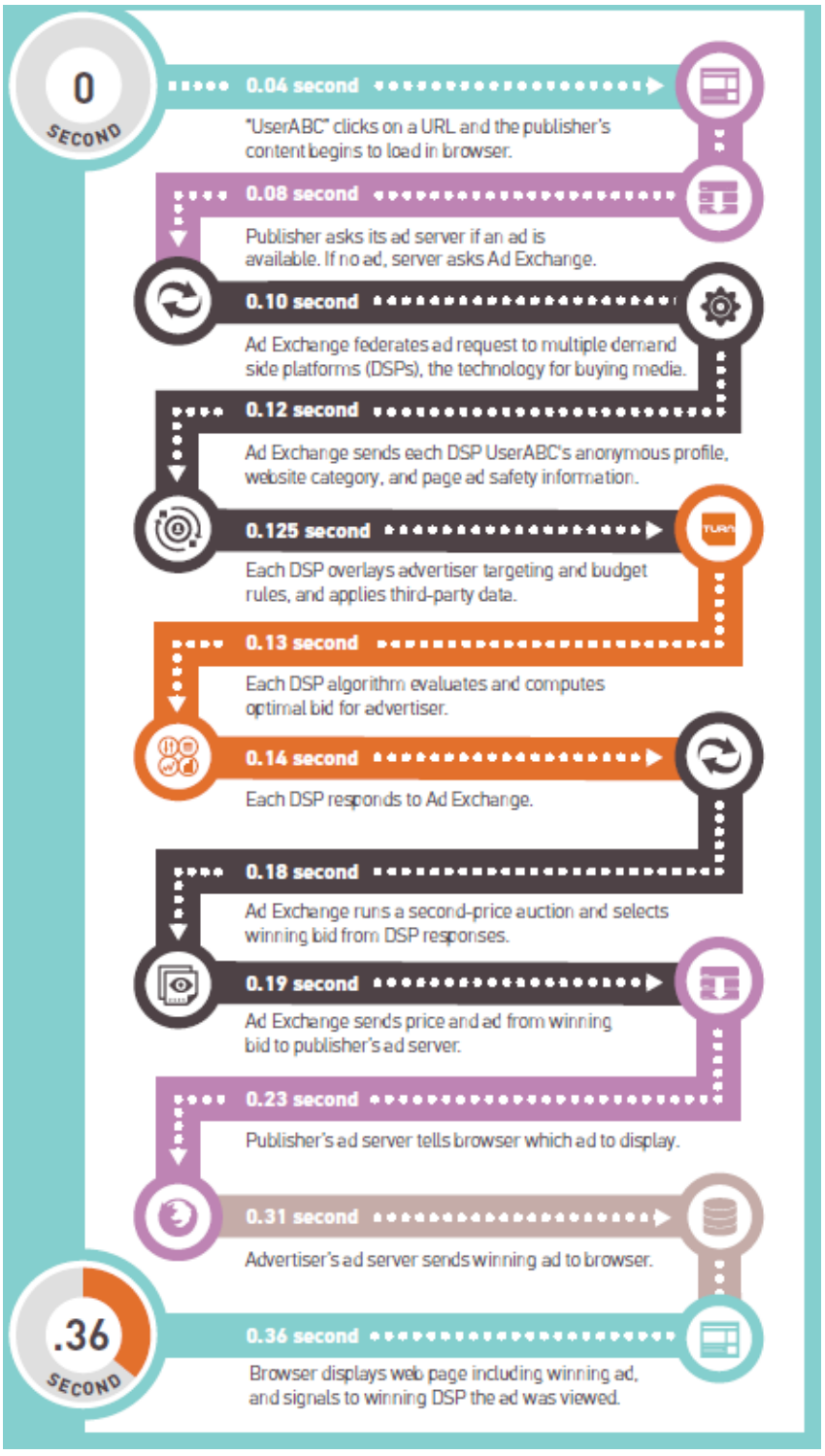
Questions for Discussion

1. What is the value of programmatic advertising? What are its strengths and weaknesses?
2. Can the success of programmatic advertising in digital media cross over to other media such as television?
3. What role should the agency play in programmatic advertising? If the existing model needs to change, what would the agency's business model look like?

Exhibits

Exhibit 1

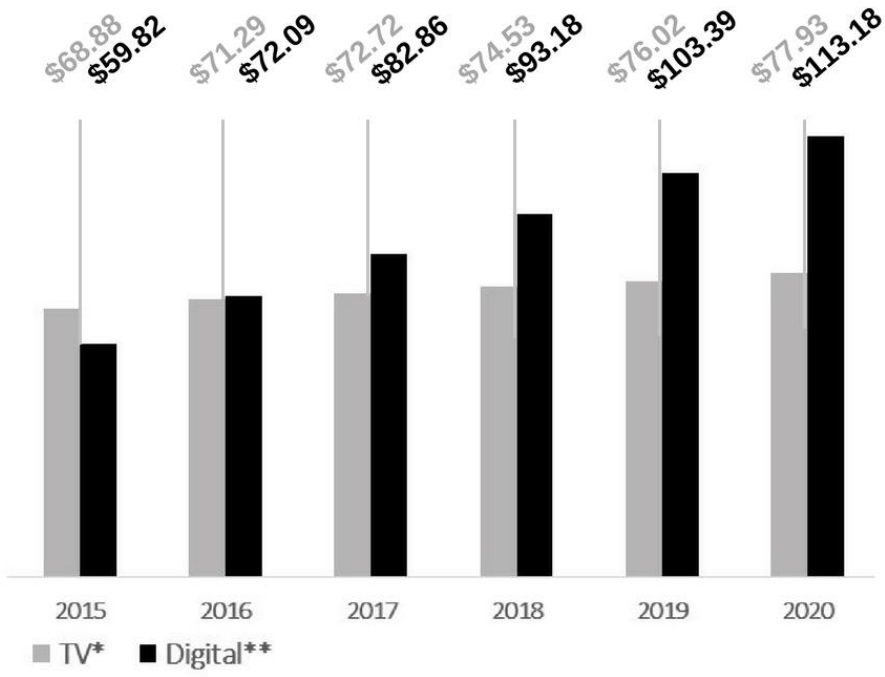
The Automated Advertising Process



Source: "The Life of an Ad," Turn.com, http://www.turn.com/resources/the-life-of-an-ad.

Exhibit 2
Growth in Digital Advertising (US)

US TV* VS. DIGITAL AD SPENDING, 2015–2010 (US $BILLIIONS)**

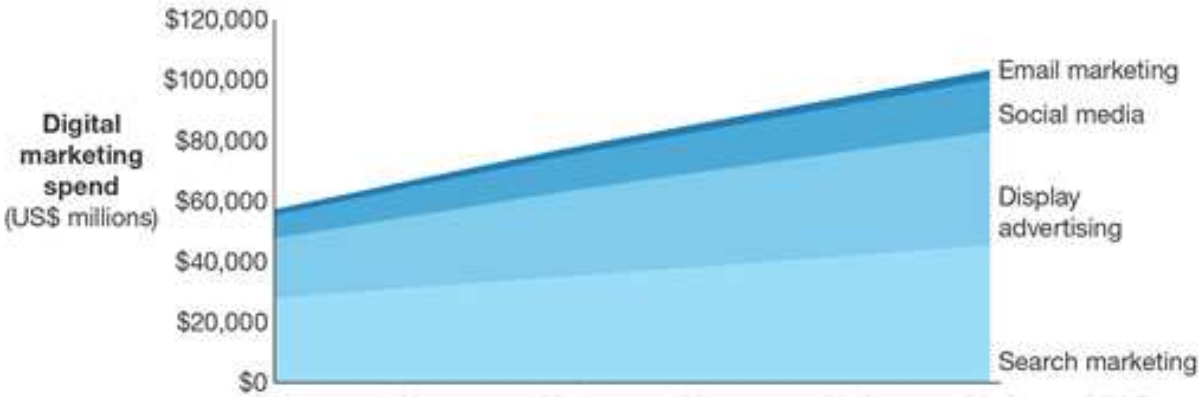


Note: *Includes broadcast TV (network, syndication, and spot) and cable TV; **Includes advertising that appears on desktop and laptop computers as well as mobile phones, tablets, and other Internet-connected devices, and includes all the various formats of advertising on those platforms.

Source: eMarketer, September 2016.

Exhibit 2 (continued)

US DIGITAL MARKETING SPEND FORECAST (BY CHANNEL), 2014–2019



	2014	2015	2016	2017	2018	2019	CAGR
Email marketing	$2,067	$2,266	$2,466	$2,665	$2,865	$3,067	8%
Social media	$7,518	$9,736	$11,724	$13,511	$15,359	$17,342	18%
Display advertising	$19,801	$23,680	$27,916	$31,281	$34,477	$37,574	13%
Search marketing	$27,899	$31,622	$34,995	$38,470	$41,890	$45,386	10%
Total	**$57,285**	**$67,305**	**$77,101**	**$85,928**	**$94,593**	**$103,370**	12%
Percentage of all ad spend	24%	27%	30%	32%	33%	35%	

Note: All numbers rounded down.

Source: Forester Research.

Exhibit 3

Total Global Spending by Category* (US $millions) Category	2009	2010	2011	2012	2013	2014p	2009-2014p CAGR (%)	2015	2016	2017	2018	2019	2014-2019 CAGR (%)
Digital Advertising	60,336	70,756	81,544	94,065	109,686	127,345	16.1	146,617	168,538	190,822	211,955	231,442	12.7
Broadband	234,137	267,784	313,039	355,947	393,274	429,280	12.9	463,826	500,510	539,361	581,203	624,613	7.8
TV Advertising	136,792	152,824	159,985	168,749	173,314	183,501	6.1	189,445	202,511	208,960	223,099	233,876	5.0
In-Home Video Entertainment	257,841	270,985	283,287	297,662	310,783	323,408	4.6	331,922	347,781	358,950	370,224	381,648	3.4
Audio Entertainment	92,551	91,294	92,470	93,681	96,559	95,636	0.7	96,984	98,772	100,667	102,767	104,648	1.8
Cinema	30,147	31,692	32,245	34,719	35,972	37,133	4.3	39,359	41,614	43,799	45,834	48,334	5.4
Out-of-Home	24,817	27,044	27,816	29,150	30,672	31,747	5.0	33,220	34,824	36,468	38,337	40,334	4.9
Consumer Magazine Publishing	65,573	65,010	65,376	6,365	61,167	59,061	(2.1)	57,640	56,546	55,710	55,080	54,610	(1.6)
Newspaper Publishing	153,392	154,521	153,900	150,311	145,688	142,430	(1.5)	140,647	139,917	140,023	140,766	141,968	(0.1)
Consumer Books	69,687	70,034	69,504	69,944	70,750	72,357	0.8	72,976	74,020	74,794	75,425	75,968	1.0
Educational Publishing	38,619	39,608	40,135	39,347	39,955	40,980	1.2	41,624	42,138	42,629	43,241	43,929	1.4
Video Games	55,190	57,791	60,822	66,444	73,973	84,534	8.9	94,117	103,454	111,634	118,738	124,542	8.1
Total	1,208,470	1,286,526	1,364,933	1,446,077	1,521,420	1,603,951	5.8	1,681,314	1,779,536	1,868,556	1,996,897	2,061,479	5.1

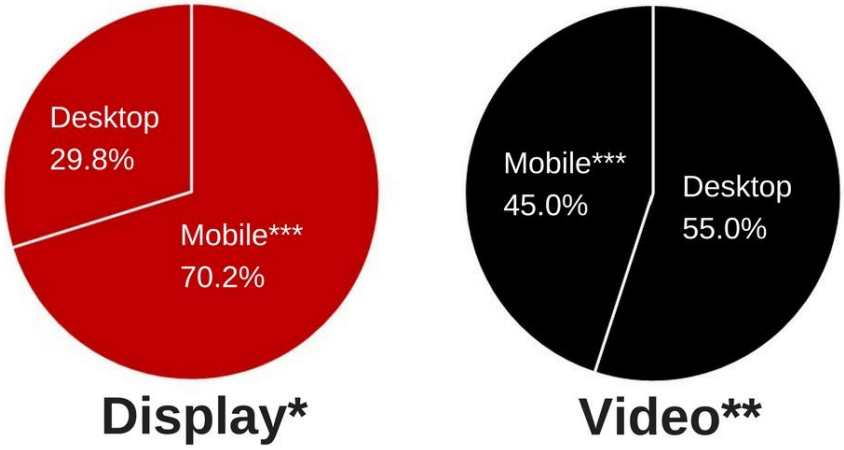
*At average 2014 exchange rates.

Note: Television, audio, newspaper, and consumer magazine digital advertising as well as video game advertising are included in their respective segments and also in the digital advertising segment, but only once in the overall total.

Source: McKinsey Global Media Report, 2015.

Exhibit 4

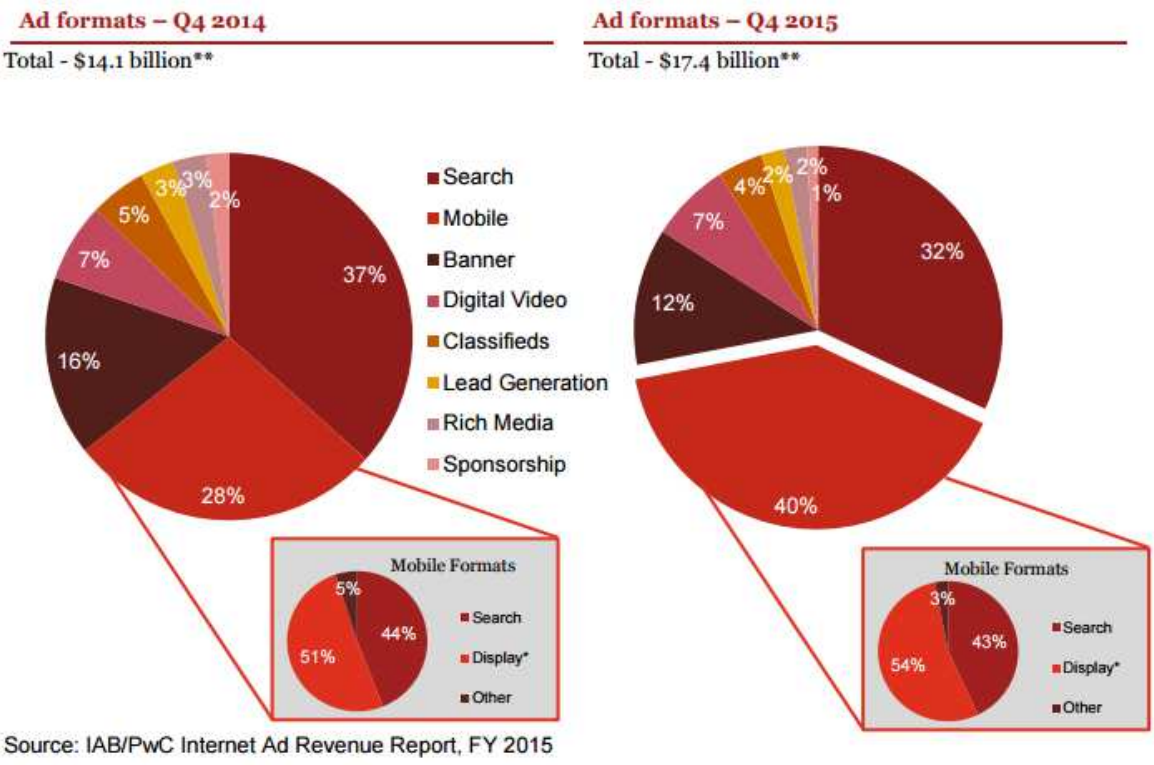
US Programmatic Digital Display* and Video** Ad Spending Share, by Device, 2016 (% of total)



Note: Digital display ads transacted via an API, including everything from publisher-erected APIs to more standardized RTB technology: *includes native ads and ads on social networks like Facebook and Twitter; **includes advertising that appears before, during, or after digital video content in a video player; ***includes ad spending on tablets.

Source: "Mobile Fueling Higher-than-Expected Growth of Programmatic Ads," EMarketer, September 26, 2016, https://www.emarketer.com/Article/Mobile-Fueling-Higher-than-Expected-Growth-of-Programmatic-Ads/1014521.

Exhibit 5
Digital Advertising Revenue by Ad Format

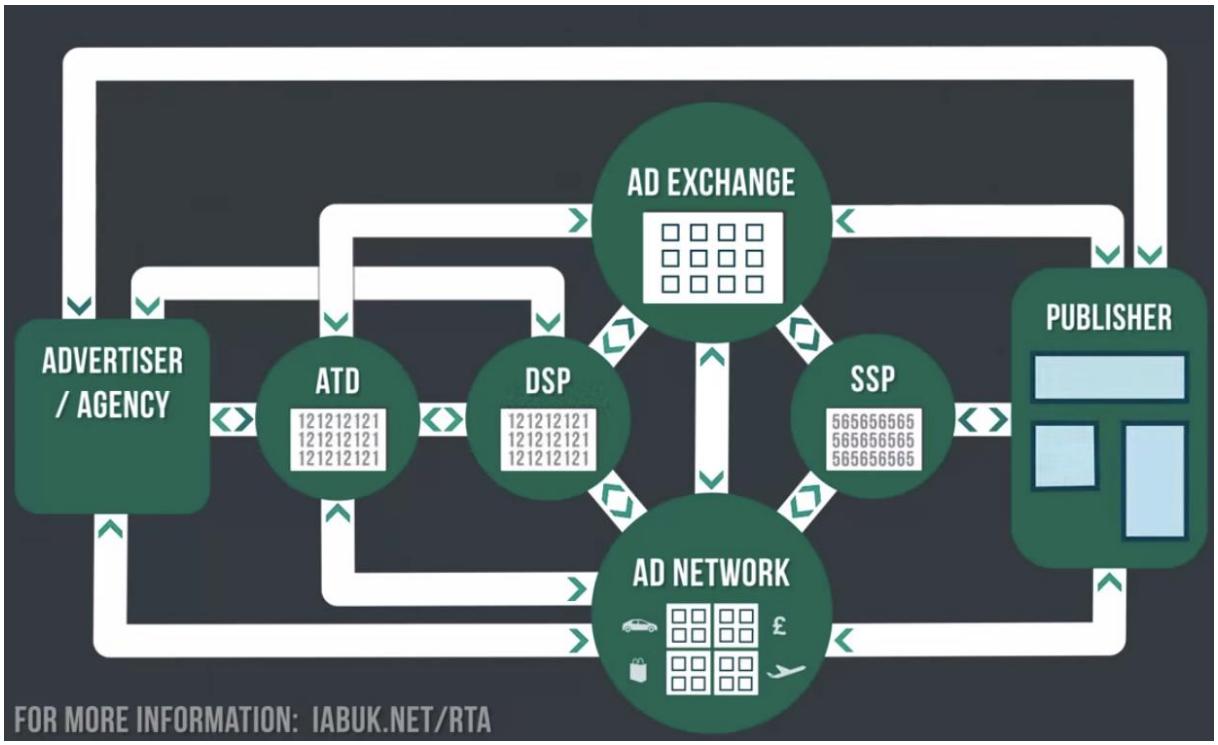


Source: IAB/PwC Internet Ad Revenue Report, FY 2015

** Mobile Display includes: banner ads, digital video, digital audio, sponsorships, and rich media advertising served to mobile devices.*
*** Amounts may not equal 100% due to rounding and omission of minor categories.*

Source: Interactive Advertising Bureau, "IAB Internet Advertising Revenue Report," April 2016, http://www.iab.com/wp-content/uploads/2016/04/IAB_Internet_Advertising_Revenue_Report_FY_2015-final.pdf.

Exhibit 6
Programmatic Ecosystem

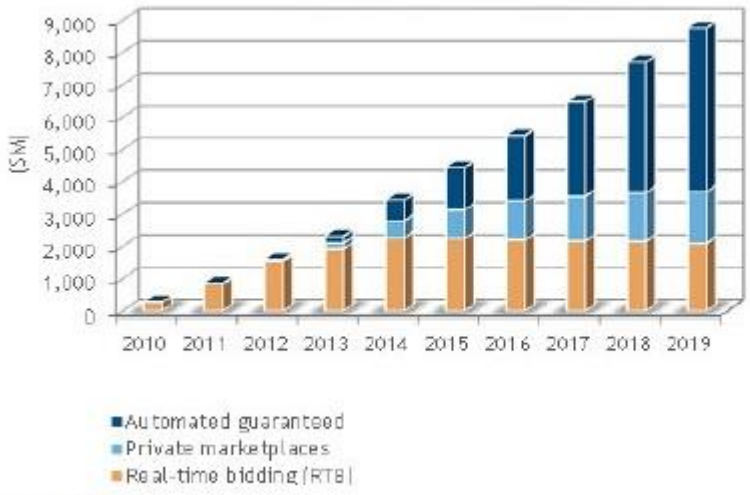


Source: "The Evolution of Online Display Advertising," IABUK.NET/RTA, Image from https://www.youtube.com/watch?v=1C0n_9DOlwE, May 13, 2012.

Exhibit 7

Types of Channels

US PROGRAMMATIC ONLINE DISPLAY ADVERTISING BY CHANNEL, 2010–2019



Source: IDC, 2015.

US PROGRAMMATIC ONLINE DISPLAY ADVERTISING BY CHANNEL, 2019–2019 ($M)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2014-2019 CAGR (%)
Real-time bidding (RTB)	281.80	844.20	1,531.40	1,925.80	2,259.00	2,248.30	2,203.60	2,173.30	2,164.60	2,102.60	(1.40)
Growth (%)	NA	199.60	81.40	25.80	17.30	(0.50)	(2.00)	(1.40)	(0.40)	(2.90)	
Private marketplaces (PMP)	-	9.50	34.90	190.00	526.40	889.50	1,209.40	1,388.20	1,499.70	1,584.40	24.70
Growth (%)	NA	NA	NA	444.50	177.10	69.00	36.00	14.80	8.00	5.70	
Automated guaranteed	-	-	31.50	193.70	648.00	1,299.10	2,013.10	2,917.10	4,039.70	5,071.10	50.90
Growth (%)	NA	NA	NA	515.60	234.50	100.50	55.00	44.90	38.50	25.50	
Total	281.80	853.70	1,597.80	2,309.50	3,433.30	4,436.80	5,426.10	6,478.60	7,704.00	8,758.00	20.60
Growth (%)	NA	203.00	87.20	44.50	48.70	29.20	22.30	19.40	18.90	13.70	

Note: IDC did not separate Preferred Deals but included them as part of the non-guaranteed channel. IDC estimates that preferred deals account for 10-20% of that segment.

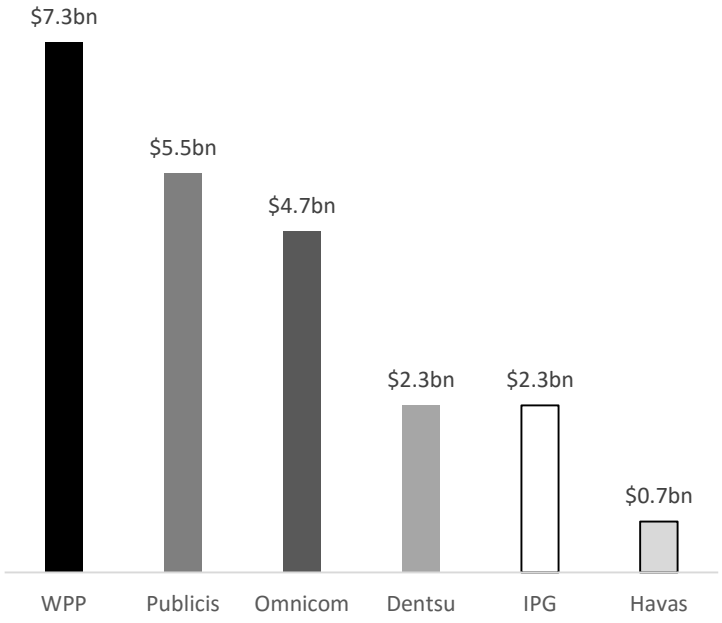
Source: IDC, 2015.

Exhibit 8

Types of Fraud

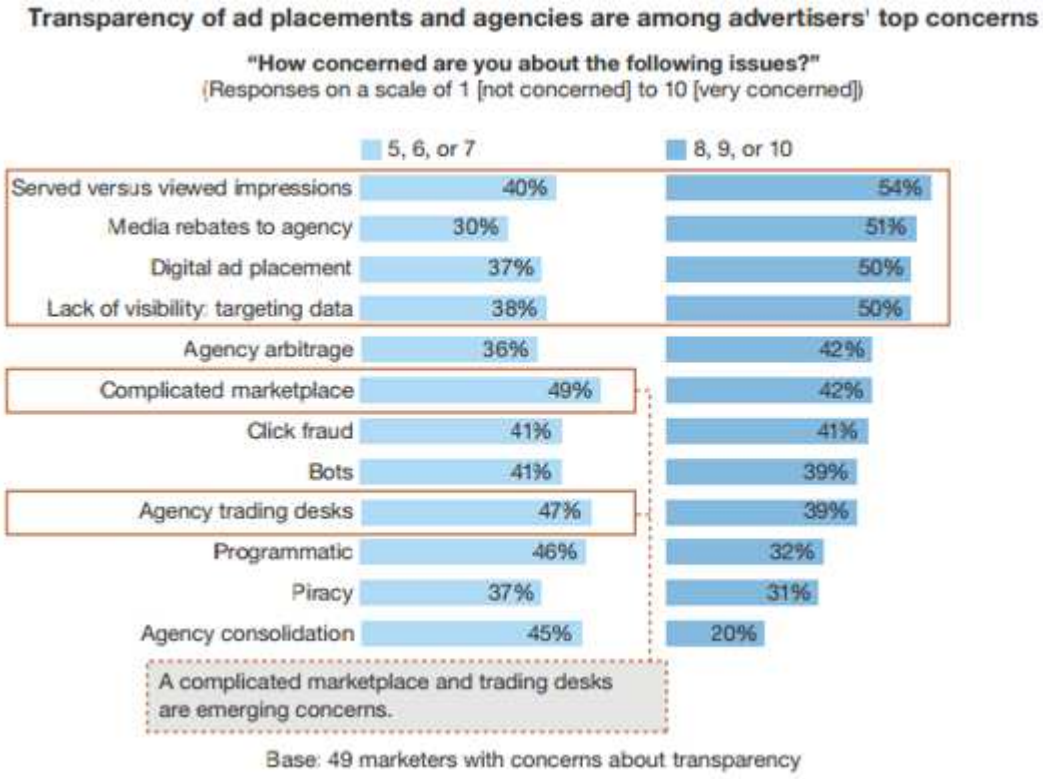
- Bot fraud: Publishers pay third parties to deliver traffic to their websites. The publishers assume that it is real traffic: but, the third party may be using Internet bots to visit the page and create page views, which the publisher reports to the ad networks.
- Robot retargeting: A retargeting fraudster can create a bot that follows predictable steps on a website; for instance, the bot may click on specified pages of an automaker's website to generate a payment to the retargeting company.
- Ad injection: Fraudsters can create browser extensions that insert ads into high-value legitimate websites. These ads are listed on ad exchanges, but all the revenue from them goes to the insertion creator.
- CMS hacking: Many content management system (CMSs) users use the ID “admin” and simple passwords that can be hacked. Once inside a publisher’s website, hackers can set up their own pages and list them on ad exchanges to buyers who think they are purchasing premium domains.
- YouTube resales: Google prohibits third-party resale of YouTube ads, but low-priced YouTube inventory often hits the market, and much of it is phony. While Google says it has resolved this issue (and offered full refunds), the practice still exists on other exchanges.
- Impression stacking fraud: Ads can be “stacked” behind videos or automatically refreshed: these processes create additional impressions even though the person viewing the video never sees these ads.

Exhibit 9
Digital Revenues from Major Ad Agencies (US $billions)



Source: WPP Annual Report.

Exhibit 10
Marketer Concerns



Source: 2014 ANA/ Forrester Evolution of Media Buying Survey.

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