



COMMERCIAL DRONE ADOPTION IN AGRIBUSINESS

Disruption and Opportunity

Ipsos Business Consulting

Build · Compete · Grow

FOREWORD

Driven by increasing affordability, portability, and wireless mobile connectivity, the civilian application of drones has extended from consumers and hobbyists to commercial use. The range of applications covers infrastructure, construction, agriculture, media and entertainment, insurance, transportation and logistics, telecommunications, security and surveillance, as well as mining industry segments.

At Ipsos Business Consulting, we actively evaluate market opportunities and potential industry disrupters across specialty sectors for our clients. Our assessment of the global commercial drone manufacturing landscape, industry applications, and business implications of this dynamic aerial technology identifies agricultural drones as a nascent but most critical market segment within commercial drone applications with regards to business opportunities for agribusiness value chain players, farm operators, farm service providers, and commercial drone manufacturers, with macroeconomic implications to food security, trade, manufacturing, and sustenance for everyday consumers.

Amidst varying projections and outlooks on the economic impact of agriculture drones, it becomes imperative to precede with examining the underlying context, value propositions, and models of adoption to grasp the momentum and extent of agriculture drone adoption in agriculture as well as impacts to the value chain players in the commercial drones and agribusiness industry. Our study explores current developments, market opportunities, management system transformations, and selected market readiness for the adoption of commercial drones in agriculture.

Ipsos Business Consulting
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INTRODUCTION

The earliest application of commercial drone technology in agriculture came to market in late 1970s Japan, where low-altitude aerial farm monitoring, crop spraying, and aerial seeing equipment was developed to mitigate the labour pressures on an aging farming population.

Within the agriculture industry, Japan and the US have been early adopters of aerial agriculture tools such as satellite imaging, aerial crop dusting, and particularly, agriculture drones. Current adoption of aerial agricultural tools in South East Asia and China is limited, however, current global production of agriculture drone aircraft are led by Chinese hardware manufacturers. Integrated agriculture drone products combining software, data services and hardware on the other hand are primarily led by North American and European firms.

Commercial production of agriculture drones has only recently geared up from incubation to commercialisation. Investments in agriculture drones increased 344% between 2013 and 2015 from US\$ 94.1 million to US\$ 323.9 million, and the business potential of this technology is lucrative in both efficiency and value. Some studies conclude agriculture drones could conserve up to 90% of water usage for irrigation, between 30% to 50% in chemicals for crop spraying, and be from 40 to 60 times more efficient than manual labour.

In addition to farm operators looking to agriculture drones as a tool for crop spraying, remote sensing, and farm management, major crop science companies such as Monsanto, Bayer and Dow Dupont are also investigating formulation requirements by drone delivery, as well as integrating crop data with Decision Support Systems (DSS) to provide simple and actionable solutions to farm operators.

Reviewing the application areas and current developments surrounding agriculture drones, we explore the landscape surrounding early adopters, growth opportunities for value chain players involved, and also evaluate the prospects of agriculture drone adoption in a study of selected Asian countries.

ADOPTION AND IMPACT OF COMMERCIAL DRONES IN AGRICULTURE

TECHNOLOGICAL DISRUPTION AND BLUE OCEAN

Current estimates of the market value potential of commercial drones vary by up to US\$ 100 billion.

Several publications are speculating on the outlook and impact of commercial drones and agriculture drones over the next 10 years. Estimates on the global commercial drones market range between US\$ 2 billion to US\$ 6.5 billion by 2020. Some outlooks estimated the total addressable market for commercial drones to be as high as US\$ 130 billion in 2015 and other sources expect the economic impact to reach US\$ 80 billion by 2025.

Some publications anticipate the agriculture drones market will reach US\$ 3.7 billion and economic impact to reach US\$ 30 billion by 2025, and a current addressable market impact of US\$ 32.4 billion. An analysis by the Association for Unmanned Vehicle Systems International forecasts the agriculture drone segment to account for up to 80% of the total commercial drone market by 2025.

There are considerable discrepancies between leading estimates and indicators of the total impact and rate of adoption for commercial drones to market. Between global market projections and fragmented R&D pilot testing, there is little information on how agriculture drones can be adopted under different contexts. However, this should not shroud the overall significance of commercial drones in the agriculture industry.

According to the United Nations Food and Agriculture Organisation, world population is projected to increase by 25% by 2050, reaching a total population of 9.2 billion people. Although cold chain logistics will help mitigate food wastage and increase calorie consumption, developing countries will continue to demand better nutrition and variety of food. Limited access to food supply in developing countries is the key driver for projections to increase food production by 70% to meet global food demands by 2050.

To achieve this, The Global Harvest Initiative GAP Report estimates the Total Factor Productivity (“TFP”¹) in agriculture needs to increase by 1.75% annually by 2050 to sustainably meet global food demand.

With slowing TFP in East Asia and Southeast Asia, adoption of improved technology in agribusiness is at the forefront of national strategic policy goals to amplify food production output through enhancing cooperation between the private sector and agricultural infrastructure developments.



¹Total Factor Productivity (TFP) refers to a variable that measures the efficiency of total inputs used per unit of output. Increases in TFP is usually the result of technological improvements or innovations. China’s 13th Five Year Plan, Thailand’s 4.0 development plan 2017 – 2036, the Philippine Development Plan 2017 – 2022, South Korea’s ‘Creative Economy’ national vision, and Japan’s 2016 agriculture G7 meeting are examples of national strategic policy goals that point towards cooperation between the private sector and public sector to introduce agriculture machinery and agri-robotics for national food security.

For more information on commercial drone outlooks, please refer to PWC Research & Insights; ABI Research; MarketsandMarkets; Grand View Research, Inc.; Frost & Sullivan; Lux Research Inc.; Association of Unmanned Vehicle System International; WinterGreen Research Inc.

Source: Food and Agriculture Organisation (United Nations); Global Harvest Initiative 2015 GAP Report; Association for Unmanned Vehicle Systems International; Ipsos Business Consulting Analysis

AGRICULTURE DRONE DEVELOPMENT SOFTWARE AND HARDWARE PROVIDERS

Chinese firms dominate civilian drone aircraft hardware manufacturing, whereas North American and European firms lead in software development and integrated products.



Note: Examples of drone companies above are for general information reference only
Source: Ipsos Business Consulting Analysis

Hardware manufacturing for civilian drone aircraft is led by Chinese firms such as DJI, YUNEEC, EHANG, Xaircraft, and TTA. agriculture drones produced by Chinese firms are commonly manufactured with applicators for spraying and seeding.

Drone software companies and integrated aerial data service providers are primarily based in North America, for example 3D Robotics, INSITU, Precision Hawk, Aeryon, DroneDeploy, and ESRI.

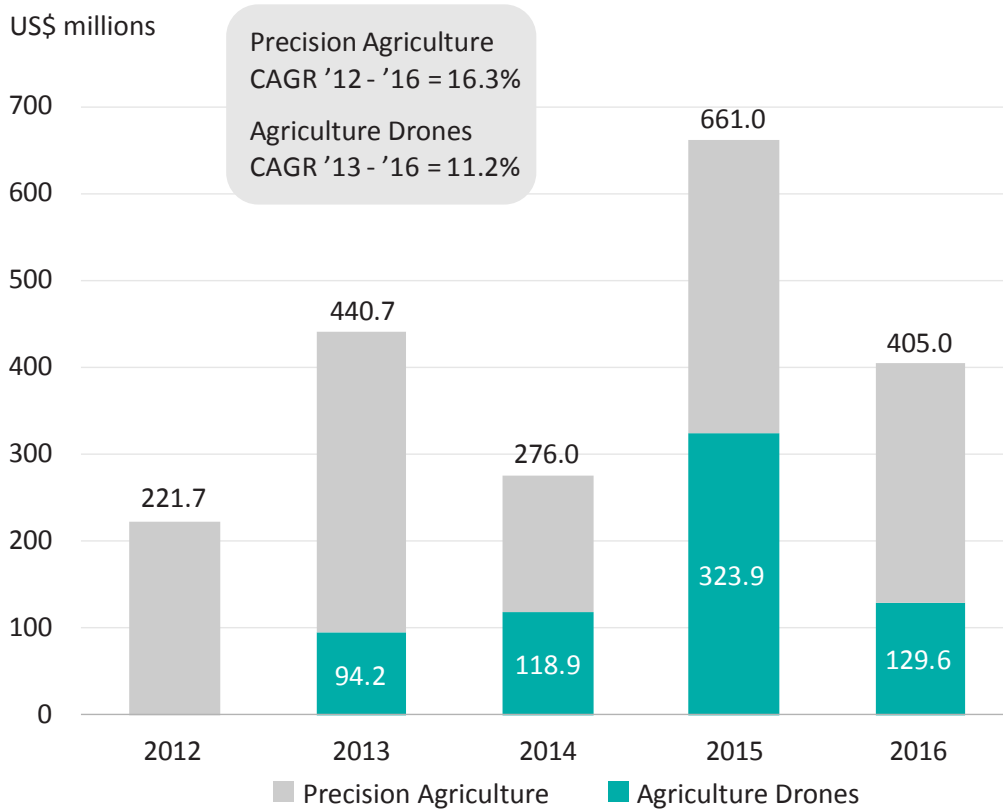
Integrated agriculture drone manufacturers and data service providers typically produce drone aircraft with LiDar or multispectral imaging without spraying applications. More manufacturers are expanding into the agriculture drone space, with recent entrants including DJI and TTA.

In the highly competitive hardware market, several drone manufacturers have announced layoffs or product delays, or have exited the market due to lack of funding in 2016. Some of these companies include 3DR, Parrot, Lily drone, GoPro's Karma, Cyphyworks, and Autel Robotics. Several businesses are also putting more emphasis on software and data analytics drone services, particularly for agriculture drones, where there is more value and competitive advantage.

CAPITAL INVESTMENT FOR AGRICULTURE DRONES

Investment in agriculture drones has surged in the past 3 years, growing by US\$ 229.7 million alone between 2013 and 2015.

Investment in Precision Agriculture and Agriculture Drones



Source: "AgTech Investing Report" by AgFunderNews; Ipsos Business Consulting Analysis

Venture capital funding for overall consumer and commercial drone manufacturing companies recorded US\$ 570 million in 2015, with DJI raising US\$ 75 million in series B, YUNEEC with US\$ 60 million in venture capital, and 3D Robotics raising US\$ 50 million in series C. Total investment in consumer and commercial drones was expected to reach US\$ 1 billion by the end of 2016.

Year-on-year venture capital funding for precision agriculture and drones declined by 30% between 2015 and 2016, after a few large financing deals were recorded in 2015, and an overall wait-and-see period by investors followed for results from previous funding. The overall trend for agriculture drone investment between 2013 and 2016 increased at a CAGR of 11.2%.

Momentum in venture capital funding for agriculture drones increased from US\$ 94.1 million to US\$ 323.9 million between 2013 and 2015. The investment trend in precision agriculture is moving towards the development of integrated platforms between operators, suppliers, equipment, and data analytics. In 2016, 32% of recorded investment in precision agriculture was in agriculture drone technology, and approximately 28% was in software development across precision agriculture.

APPLICATIONS IN TRADITIONAL, MODERN, AND PRECISION AGRICULTURE

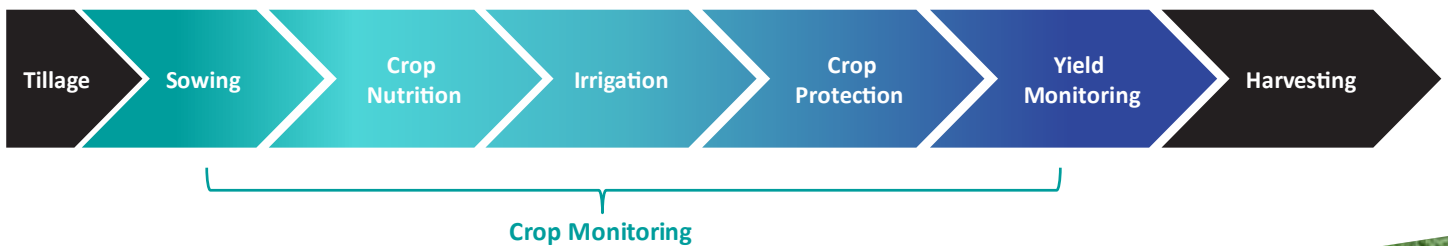
In addition to precision agricultural practices, agriculture drones also disrupt and displace traditional and modern agricultural farming practices. Particularly since existing farm management equipment is limited to aerial-only or ground-only applications. Agriculture drones can bridge the gap to deliver both aerial and ground farm management functions, simultaneously integrating both crop monitoring and crop protection applications with higher precision at lower cost.

Current agriculture drones have multi-application capabilities, extending from basic flight control and photographic imaging, to hyperspectral data analytics, GPS guided automated flight, and payload delivery of variable rate spraying of seeding, fertilisers, and pesticides. The range of functions agriculture drones can perform increases the points of engagement and feedback loop between crop science companies and farm operators – transforming the traditionally reactive farm management model into a proactive decision-making engagement.

The diagram below illustrates the farming stages agriculture drones can now cover in terms of crop monitoring, protection, and application.

While agriculture drones have been promoted as high-tech, precision agricultural tools, not all farm operators are turning to agriculture drones to maximise production and minimise risk. An often overlooked opportunity for agriculture drones lies in utilising the basic functions of this technology, such as photo surveillance of crops, general crop dusting, irrigation, fertilisation, and seeding, and also as a resource solution to support productivity and terrain challenges faced by traditional grounded farm equipment and manual labour.

Farm Management System – Agriculture Drone Application



AGRICULTURE DRONE APPLICATION FOR CROP TYPE AND FARMING CONDITIONS

Implementation of agriculture drones vary depending on crop type, farm size, terrain landscape, and crop protection challenges. The aerial mobility, location landing, and payload delivery features of agriculture drones introduce a convenient navigation and accessibility solution to monitor and manage fragmented, small, and irregular terrain farm areas.

Agriculture drones can cater to specialty crops, such as grapes, avocados, pineapples, persimmon, and tea plants requiring precision agriculture functions, as well as to subsistence crops, such as rice, potatoes, corn, and grains, typically serviced by industrial agricultural machinery complemented by crop imaging from agriculture drones.

Ideal Conditions for Agriculture Drone Adoption

Existing Farming Conditions:

- Smaller, scattered, irregular plots of land
- Some machinery usage, more manual
- Plot accessibility challenges
- Emphasis on adopting precision farming

Crop Type:

- Paddy fields (wetlands)
- Highland crops
- Stalk crops (corn, sugarcane)
- Fruit production and delicate produce
- Cash crops

Source: Ipsos Business Consulting Analysis



BUSINESS IMPACT OF AGRICULTURE DRONES

Agriculture drones can replace functions previously served by satellites, manned aerial aircraft, ground machinery, and manual labour. The technological disruption of agriculture drones transforms the efficiency of agricultural productivity through optimising land utilisation while reducing input factors such as labour, water, and agricultural chemicals. Below are some examples of the business impact agriculture drones can deliver.

Imaging

- Compared to satellite or manned aircraft, imaging by agriculture drones is comparatively less expensive for fields smaller than 20 hectares, and can capture higher resolution images with less aerial obstruction
- Agriculture drones can cover photographic to hyperspectral imaging in a single preprogrammed flight, with real-time feedback for field zone management
- Image frequency is a factor that also renders agriculture drones more cost efficient in the long run

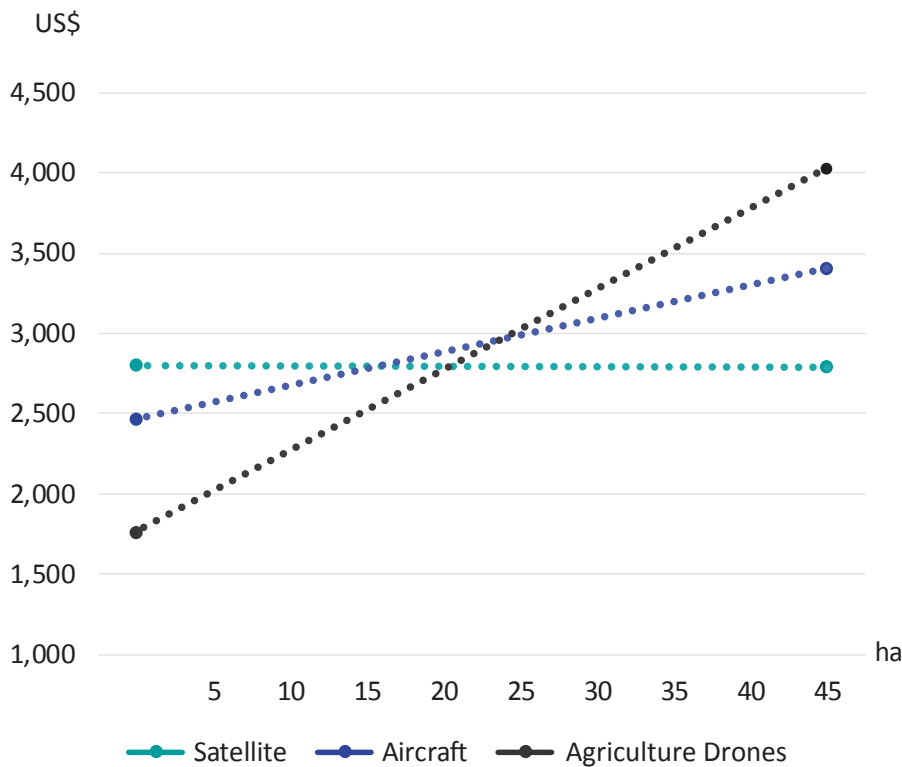
Input Application

- Spraying by agriculture drones is estimated to save up to 90% of water usage for irrigation, and could save between 30% to 50% of chemicals in crop spraying

Productivity

- Remote controlled agriculture drones expose operators to fewer chemicals
- Agriculture drones are estimated to improve efficiency by between 40x to 60x compared to manual labour, and up to 5x faster than tractor application of pesticide

Cost comparison for satellite, aircraft, and agriculture drone imaging



Source: DroneApps, Ipsos Business Consulting Analysis

EARLY ADOPTERS

Given the breadth of application agriculture drones can deliver in crop management, potential cost savings achieved by agriculture drones from increasing production and reducing inputs, as well as the corresponding impact to the local and global input value chain players, it also becomes critical to investigate the extent that agriculture drones can be adopted in each market.

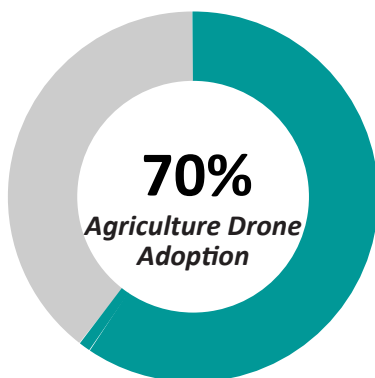
In the following section, we examine the United States and Japan as case studies of early country adopters of agriculture drone technology to evaluate differing paths and drivers of adoption for agriculture drones in emerging country markets.

As an initial review, selected Asian countries of interest are measured against our pillars of attractiveness to identify potential roadmaps for adoption in each market. These pillars include the openness of the market's regulatory environment, crop value contribution to the country's domestic output, the existing productivity challenge to local agricultural practices, existing market adoption of aerial agricultural tools, and current attractiveness of precision agricultural farming practices and technology for each country.

EARLY ADOPTERS OF AERIAL AGRICULTURE TOOLS

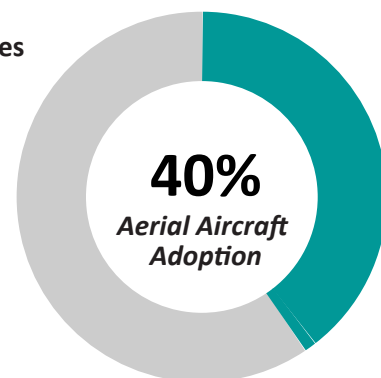
The United States and Japan have the highest adoption rates of aerial agricultural tools but have different underlying reasons for adoption. Japan utilises aerial equipment, particularly agriculture drones, to provide crop dusting and seeding to rice paddies; whereas satellite imaging, manned aircraft, and agriculture drones have been adopted in the United States for crop dusting efficiency over large fields and precision agriculture farm management.²

Japan



- **Usage:** rice paddy dusting, seeding, crop management
- **Key reasons:** aging farmers, labour shortage, challenging terrain, small land plots, domestic food demand
- **Key agriculture drone players:** Yamaha Motor, Kawada Industries Ltd., Fuji Heavy Industries Ltd., Yanmar Agriculture Equipment
- **Crop types:** rice paddies, grains, some specialty crops
- **Farm types:** small farm plots

United States



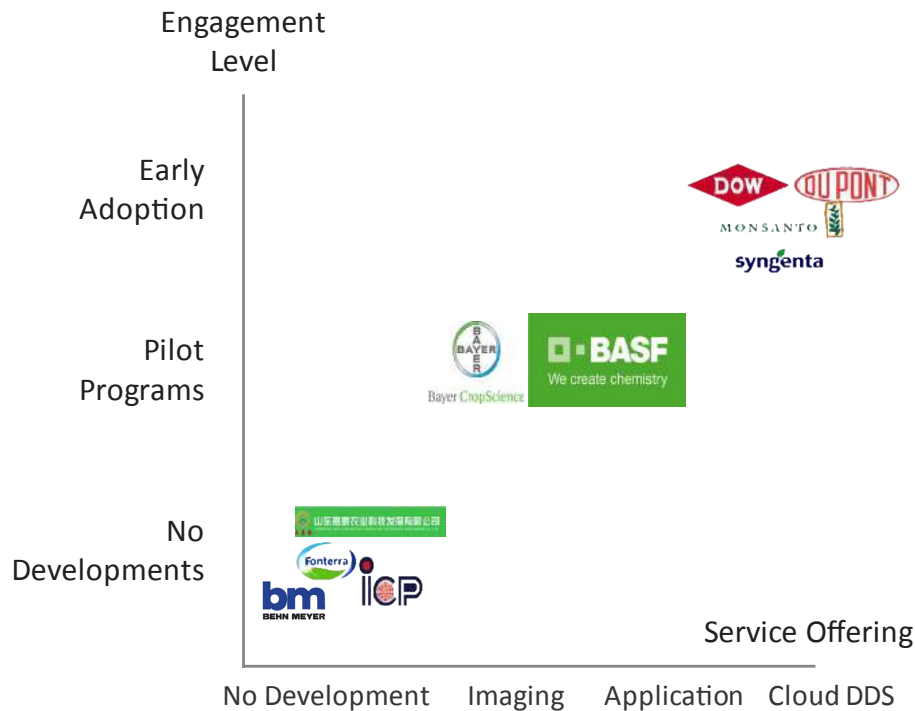
- **Usage:** crop dusting, precision agriculture crop management
- **Key reasons:** labour shortage, yield and profit incentive, reduced input requirements, efficiency
- **Key agriculture drone players:** Parrot, PrecisionHawk, Agribotix, 3D Robotic
- **Crop types:** imaging for row crops, precision spraying for specialty crops
- **Farm types:** large fields

²Note: Adoption of aerial agriculture tools noted for Japan refers to crop dusting by agriculture drones according to a 2015 Reuters essay 'Drone On.' Adoption of aerial agriculture tools in the US refers to aerial aircraft such as helicopters and airplanes being used for crop dusting. Agriculture drone adoption in the US is primarily a surveillance and imaging tool to complement existing crop dusting machinery, and for cases where precision agriculture is needed. There is no further literature at this time to document adoption levels of agriculture drones in the US. Examples of drone companies are for general information reference only.

Source: Ipsos Business Consulting Analysis

AGRICULTURE DRONE ADOPTION BY CROP SCIENCE COMPANIES

Crop science companies investigating formulation requirements and the remote sensing capability of agriculture drone technologies are also pushing for an integrated platform between crop science products and data solution offerings.



Source: Ipsos Business Consulting Analysis

Dow Dupont and Monsanto are early adopters of application (crop spraying) and developing integrated platforms for agriculture drones.

Dow DuPont joined the Series C funding of PrecisionHawk in April 2016, and are actively reviewing formulation requirements for crop spraying drones in China.

Monsanto started research on deploying drones in agriculture in the US in August 2015, and invested US\$ 11 million in Resson Canada for imaging analysis.

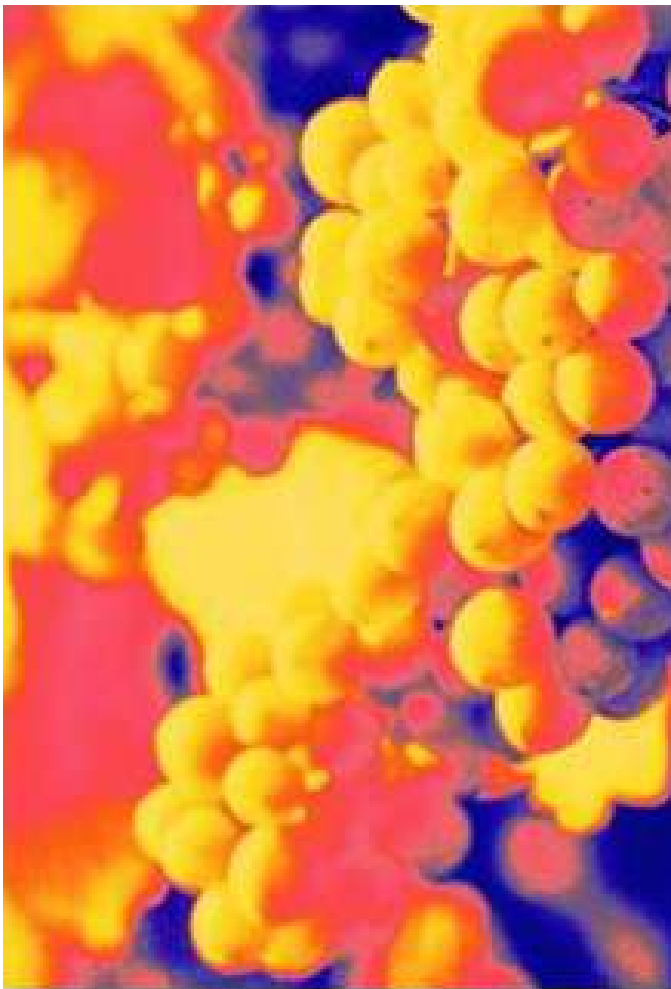
Bayer and BASF are exploring imaging and the application of agriculture drones through pilot programs with drone manufacturers.

Bayer CropScience has adopted SlantRange Drone technology, a drone sensor and imagery analytics service provider, for crop breeding and research programs in the US since the beginning in July of 2017. Bayer introduced “Drone CropStar” in 2015, a new tool to supervise and manage agricultural fields against nematode attacks in Brazil. The company has used agriculture drones in the UK since 2014.

BASF used drone camera technology to demonstrate the result of weed control in the Clearfield Production System for canola in Western Canada. In March 2016, BASF launched an online platform to help farmers improve crop management.

EMERGING OPPORTUNITIES

Agriculture drone technology is providing new market opportunities in agriculture drone aircraft leasing and crop intelligence services for the agriculture industry, targeting SME farms and specialty crops. Examples include integrated agriculture drone service providers Deveron and AgriSens. Early applications of these services, targeting specialty and cash crops, have developed crop specialisation expertise and data tracking for crop management consultations.³



Infrared imaging analysis - lighter colours absorb more infrared light, indicating ripeness

Vineyards

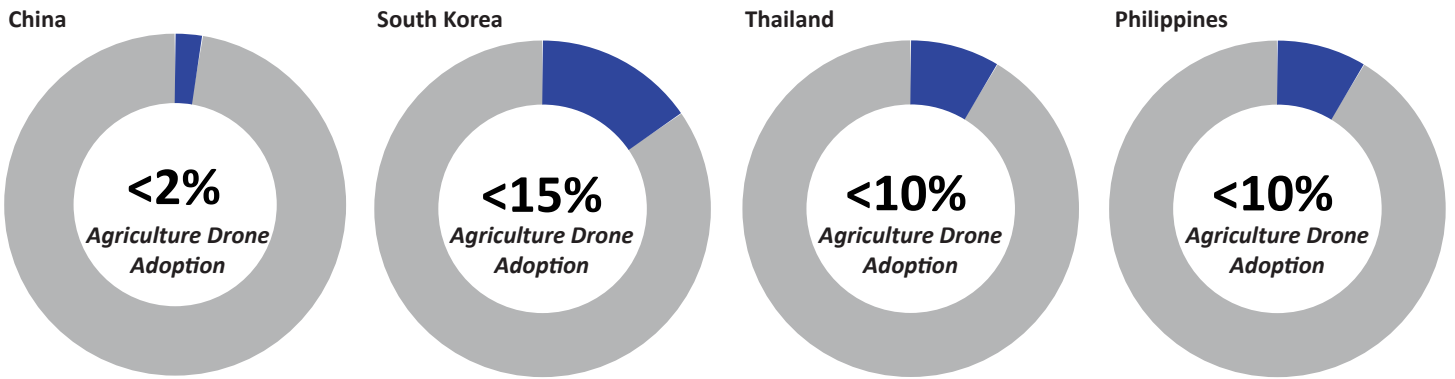
- *Agriculture drones have been deployed for wine grapes in California, USA.*
- *Full service providers such as Vine Rangers (leasing services using Yamaha RMAX drones), and Wine Flight have been built around irrigation and crop management. They assist SME farming operations to improve crop protection and crop rotation strategies, while consolidating crop intelligence to increase input efficiency and harvest yields, enabling smaller farms to compete with larger farm operations.*
- *Agriculture drone technology also enables vineyards to better test and manage new grape or crop varieties to attract more investments from improved crop performance and crop intelligence.*

³Source: Deveron, AgriSens, WineFlight, VineRangers, Ipsos Business Consulting Analysis

OPPORTUNITIES IN ASIA: CONSIDERATIONS FOR ADOPTION

CURRENT ADOPTION OF AERIAL AGRICULTURE TOOLS⁴

Current adoption of aerial agriculture tools in China affects less than 2% of farm area, but agriculture drone adoption is being driven forward by government support and subsidies. The Philippines has seen an increase in agriculture drone adoption, with the government now supporting agriculture drones for farm operators growing high-value commercial and export crops.⁵



China

- **Usage:** crop dusting, irrigation, crop protection
- **Key reasons:** aging farmers, labour shortage, challenging terrain, small land plots, efficiency, domestic food demand
- **Key agriculture drone players:** DJI, Xaircraft, TTA
- **Crop types:** rice, grains, tea, cotton, fruits
- **Farm types:** small, irregular and scattered plots
- **Examples of adoption (provinces):** Heilongjiang, Henan, Xinjiang, Tianjin, Hebei, Guizhou, Zhejiang, Fujian
- **Examples of subsidy schemes:** Henan and Fujian province (subsidies for specific agriculture drone models)

South Korea

- **Usage:** crop dusting, irrigation, crop protection, crop management
- **Key reasons:** aging farmers, labour shortage, yield and profit incentive, reducing wastage of pesticide and water
- **Key agriculture drone players:** Daewoo, Sungwoo Engineering, DJI, Yamaha
- **Crop types:** rice, grains, fruits (apples, pears, persimmon)
- **Farm types:** small farm plots

Thailand

- **Usage:** crop dusting, irrigation, crop protection
- **Key reasons:** domestic food demand, reduce crop damage from monsoon season
- **Key agriculture drone players:** G-Force Composites Co., Sri Narong War Elephant Team, TOP Engineering Group, Alliance-Ip, Aeronni Industrial Multicopters
- **Crop types:** rice, sugarcane, maize, specialty fruits for export
- **Farm types:** small farm plots

Philippines

- **Usage:** crop dusting, irrigation, crop protection
- **Key reasons:** low productivity, inefficient irrigation, weather impact (typhoons and drought), export crops, labour shortage
- **Key agriculture drone players:** SkyEye, UAV Philippines
- **Crop types:** pineapple, rice, sugarcane, coconut, other fruits for export
- **Farm types:** small, scattered, irregular farm plots, prone to typhoon and drought impact

⁴Note: Adoption of aerial agriculture tools noted for China refers to the upper limit of our estimate on current adoption of crop dusting by agriculture drones, and the adoption of aerial agriculture tools noted for Korea refers to the upper limit of our estimate on current adoption of crop monitoring and dusting by agriculture drones in terms of arable area coverage

⁵Note: Adoption of aerial agriculture tools noted for Thailand and Philippines refers to the upper limit of our estimate on current adoption of crop dusting by agriculture drones

Source: Ipsos Business Consulting Analysis

HARDWARE AND OPERATOR REGULATIONS ON COMMERCIAL DRONES

Regulation of commercial drones determines the agriculture drone aircraft type and speed of adoption by commercial operators.⁶

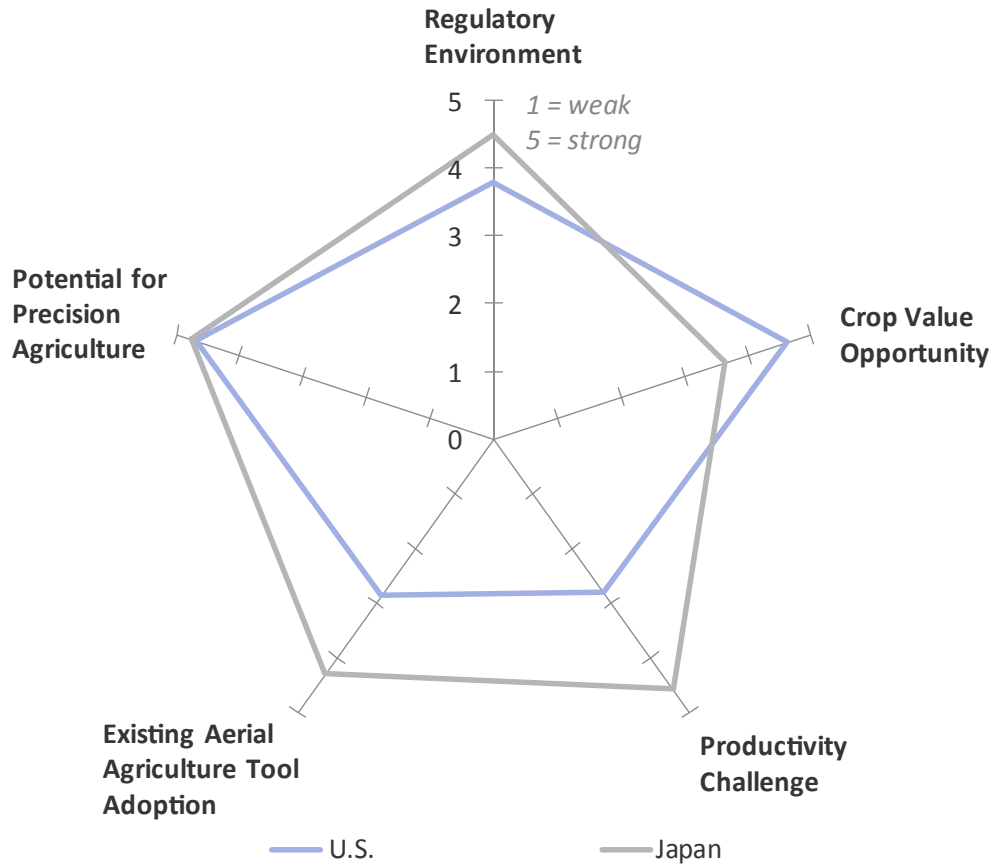
	US	Japan	China	Thailand	South Korea	Philippines
Commercial UAV Regulation Weight Classes	<ul style="list-style-type: none"> At or Less than 55 lbs (25 kg) More than 55 lbs (25 kg) 	<ul style="list-style-type: none"> More than 200 g 	<ul style="list-style-type: none"> Less than 1.5 kg Between 1.5 kg to 7 kg Between 7 kg to 25 kg Between 25 kg to 150 kg <p><i>*Commercial drone regulations class V "Crop protection class" addresses additional requirements for agriculture drones</i></p>	<ul style="list-style-type: none"> Above 25 kg 	<ul style="list-style-type: none"> Less than 12 kg More than 12 kg 	<ul style="list-style-type: none"> Less than 7 kg More than 7 kg
Maximum Altitude	400 ft (122 m)	150 m	N/A	50 m	150 m	400 ft (122 m)
Visual Line of Sight (VLOS)	VLOS required, Daytime-only operations					
Airworthiness Certification	Required	/	Not required for drones weighing less than 25 kg and flying below 150 m; required for drones between 25 kg to 150 kg	Required on a case-by-case basis	Required	Required only for large commercial drones
Drone Pilot Certification	Must have Remote Pilot Airman Certificate from Federal Aviation Administration	Necessary permission required from Civil Aviation Bureau	Operator must have an AOPA licence, unless all of the three criteria are fulfilled: <ol style="list-style-type: none"> drones under 7 kg flight altitude within 120 m flight distance within 500 m <p><i>*For agriculture drone flying beyond 15 m drone pilot certification is necessary</i></p>	Required (from the Department of Civil Aviation)	For drones exceeding 12 kg pilot must hold the Certificate of Ultra-Light Plane Operator from the Ministry of Land, Infrastructure and Transport	Requires Certificate of Authorisation

⁶Notes:
 Weight class defines the regulation category for commercial drones. Airworthiness certification refers to registration and approval by the respective aviation authority on the aircraft's safety
 Japan: regulation applies to commercial drones above 200 g; more restrictions are defined by height and density of population and housing
 Under commercial drone regulations, class V (called "Crop protection class") specifically addresses additional requirements for agriculture drones, such as protective measures for personnel handling pesticide and chemicals; requiring agriculture drone operators flying above 50 ft (15 m) to obtain drone pilot certification; and for operators to keep pesticide and chemical spraying records

Source: Civil Aviation Administration of China (CAAC); US Federal Aviation Administration (FAA); Japan Civil Aviation Bureau (CAB); Thailand Department of Civil Aviation; Korea Aviation Act; Civil Aviation Authority of the Philippines (CAAP); Ipsos Business Consulting Analysis

ROADMAP FOR ADOPTION

The five pillars illustrate different areas of potential attractiveness for agriculture drone adoption in each country.



Source: Ipsos Business Consulting Analysis

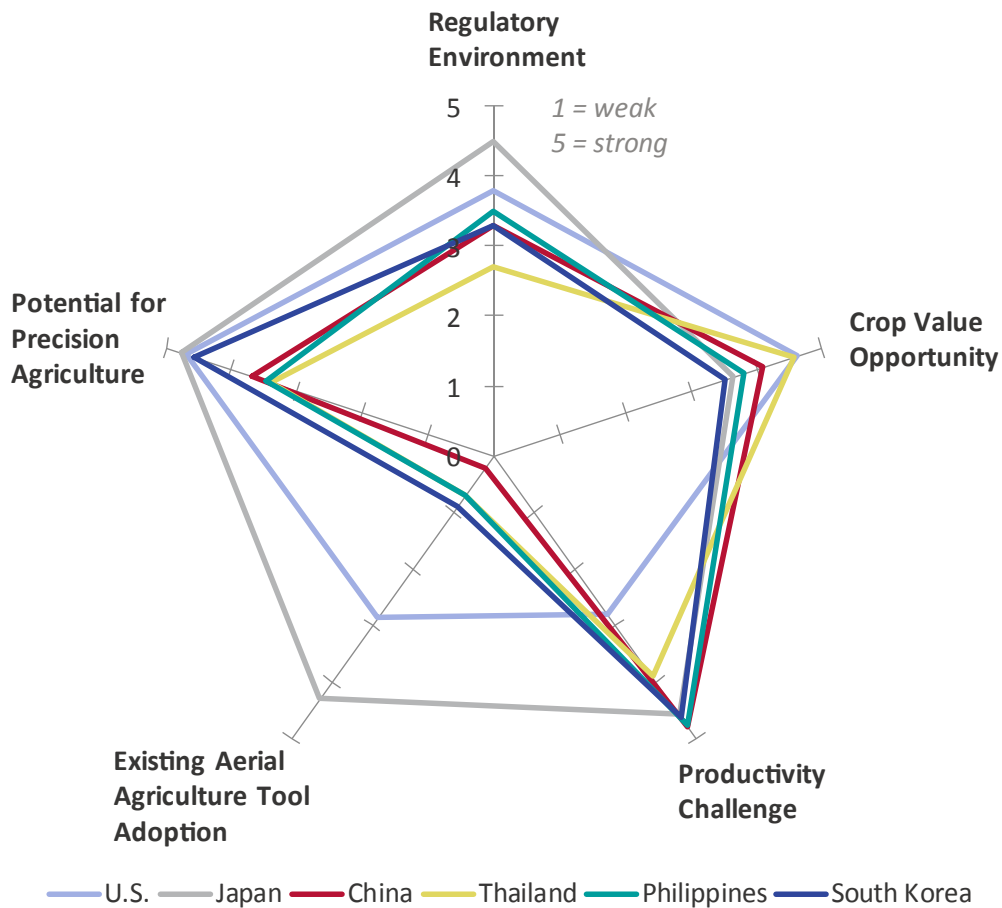
Using five pillars of attractiveness to measure agriculture drone adoption to market, the accompanying chart illustrates the degree of practical benefit that agriculture drones can bring to each identified area. For the two early adopters of agriculture drones, the profiles for Japan and the US highlight fundamental differences in the value proposition of agriculture drones in each country.

Between both countries, the market is mature in Japan and well developed in the US, the regulatory environment is encouraging for agriculture drone operations, and both countries demonstrate high potential benefit for precision agriculture usage. When examining agricultural productivity challenges (e.g., aging farmers, difficult terrain, and similar obstacles), on the other hand, the profile between Japan and the US differs the most.

In the US, with less of a productivity challenge, compared to Japan, agriculture drone adoption is geared towards precision agriculture farm management and optimising crop value productivity while maintaining or reducing inputs to production.

In Japan however, agriculture drone adoption is seen as a highly attractive method of resolving productivity challenges. Agriculture drones, in the case of Japan, are expected to be adopted as an efficiency and productivity solution for traditional agricultural practices.

These profiles illustrate the fundamental models of adoption for agriculture drones in different market contexts, and most importantly, signify the type of opportunities that crop science players and drone manufacturers can expect to encounter.



Source: Ipsos Business Consulting Analysis

Extending the comparison to China, Thailand, Philippines, and South Korea, a particular pattern emerges where the profiles show a high potential for aerial agricultural tool adoption, and a highly attractive setting for agriculture drones to address agricultural productivity challenges.

These country profiles suggest that the primary attractiveness of agriculture drone adoption is in mitigating productivity challenges in traditional and modern agricultural farming practices. However, the agriculture drone attractiveness profiles of these countries also indicate a landscape with high potential for adopting agriculture drones for precision agriculture.

We can expect to see the adoption of agriculture drones in traditional and modern agricultural practices as a precursor to future agriculture drone adoption for precision agriculture farm management.

Overall, it is worth noting that although opportunity and potential for agriculture drone adoption is significant in these four countries (high crop value opportunity and low market penetration), the regulatory environment for the operation of commercial and agriculture drones will ultimately confine the extent and rate of agriculture drone adoption in each market context, and hence, the overall value of this dynamic technology.



CONCLUSION

Assessing opportunities in Asia, our study identified clear differences in paths to adoption between Japan, US, China, South Korea, Thailand, and Philippines defined by each market's current agricultural practices and primary push factors for adoption. Each landscape's regulatory environment, productivity challenges, and economic incentives also influence the pace of agriculture drone adoption to market.

The roadmap for agriculture drone adoption in each market context will have implications to the input value chain players such as crop science companies, farm operators, and agriculture drone manufacturers.

For small and medium sized farm operators, a key implication of agriculture drones lies in utilising this tool as a solution to ease resource and productivity constraints in addition to precision agriculture capabilities by agriculture drones. Furthermore, for farm operators who do not currently practice precision agriculture, agriculture drone adoption also becomes a gateway for future adoption of precision agriculture capabilities, delivered more affordably by agriculture drone technology. Farm operators and agriculture drone service providers may consider how agriculture drone can contribute to existing farm management systems, agricultural practices, crop protection input usage, and production yields.

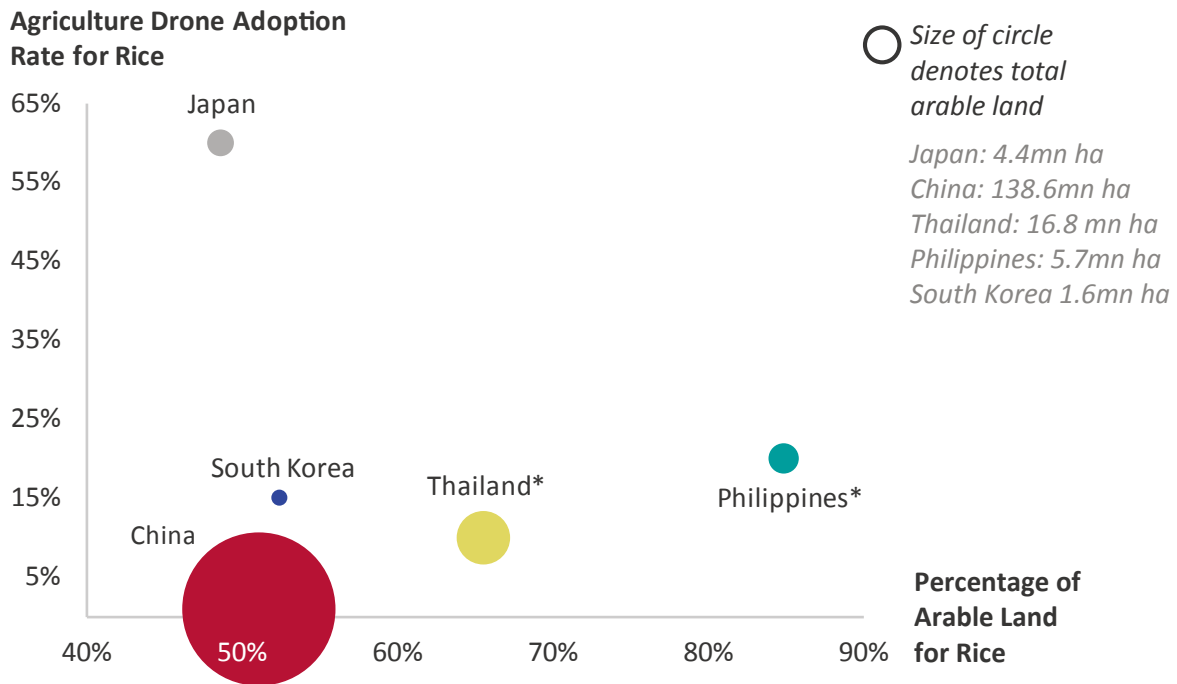
Changing farm management and farming practices with the adoption of agriculture drones will have implications for input value chain players, particularly crop science companies, due to adjustment of product usage and formulations required from agriculture drones, increased frequency of crop monitoring and product application throughout the farming cycle, and through agriculture drones, collecting crop health, productivity, and locational information on the performance of products being used. Adapting to agriculture drone technology as an emerging agriculture tool, input value chain players will need to develop new value propositions for farm operators to address the potential disruption, as well as opportunities, offered by agriculture drone adoption.

Finally, the regulatory environment for commercial drones and agriculture drone operation in areas such as quality and safety, operator certification, and insurance requirements for each country market will set the pace, scope, and type of agriculture drones to be adopted in different market contexts, carrying implications to production volumes and aircraft types offered by agriculture drone hardware companies.

For value chain players surrounding agriculture drone technology, a focused strategic assessment of each local market's path to adoption, market readiness, direct business implications, and growth opportunities will be critical for the next five years as this technology gains more traction with emerging market adopters.

AFTERWORD: ADOPTION INSIGHT - RICE PLANTATIONS

Reviewing the case of Japan's agriculture drone usage in rice plantations, the gap between adoption rate in Japan compared to emerging market adopters signals a blue ocean opportunity for our selected countries of study. For comparison purposes, we selected rice, the common staple crop between our selected countries of study to put into perspective the potential adoption of agriculture drones.



Comparing Staples

- The potential adoption of agriculture drones for rice plantations in Asia opens opportunities for drone manufacturers, crop science players, and farm operators
- Approximately 50% of Japan's cultivated area is used for rice plants, and has a 60% adoption rate of agriculture drones
- The percentage of farmland used for rice plantations in China is similar to Japan, accounting for 51% of cultivated area, but less than 1% of this land currently uses aerial agricultural tools for rice
- The opportunity for agriculture drone adoption is significant in other countries in Asia, with rice plants making up 52.4% of total arable land in Korea, 65.6% in Thailand, and 84.9% in the Philippines

*Aerial adoption for Thailand and Philippines represents a total amount of all forms of aerial adoption

Source: Food and Agriculture Organisation of the United Nations; Ipsos Business Consulting Analysis

OVER

20 YEARS

EXPERIENCE OF GO-TO-MARKET strategy in emerging and developed markets



GO-TO-MARKET

Preparing for market entry has never been so complex. The rise of global connectivity, both online and in terms of real-world trade infrastructure, means that businesses need to adapt to rapid changes throughout the world of commerce. New trade partnerships allow competition to come from all sides, e-commerce requires a revolution in logistics, and the rise of internet advertising demands mastery of this new media platform.

These new market realities affect consumer preferences in terms of products and their method of purchase, advertising models, logistics in an e-commerce world, legal requirements at every step of the way, and competitors both local and overseas. Companies must remain ready to respond to real-time evaluations of sales performance, while continuing to monitor progress toward long-term goals.

Now more than ever, a detailed understanding of the market is an essential element of a winning business model. The Ipsos Business Consulting proprietary model for Go-to-Market strategy, combined with our world-class marketing research service in 88 countries around the world, puts us ahead of the pack in preparing our clients for the new realities of the global marketplace.

Ipsos begins its Go-to-Market process with a detailed assessment of the existing marketplace to identify its needs, opportunities and limitations as well as the strengths and weaknesses of competitors. We then provide a clear entry strategy based on our clients' products and their unique selling points, identifying reliable local partners to assist in market entry.

By determining market growth potential through a realistic analysis of its drivers and barriers, Ipsos clearly maps the business landscape to show the way forward. Precise customer demographic profiles identify your target market, while a breakdown of your product value chain allows you to optimise the logistics network from end to end.

This framework allows us to identify your company's inherent strengths, match each product to its ideal marketplace, and position your brand for maximum impact. We help you set realistic goals, whether your KPIs focus on growing your market share, increasing penetration or finding a new niche for your products. Ipsos's own visual model to compare pilot projects in terms of cost, timescale, ease of implementation, and potential performance level, makes deciding on strategy a straightforward process.

With the right plan in place, we map out a realistic timeline for short, medium and long-term goals, as well as the means to measure progress towards them. Ipsos continually does due diligence on potential partnerships with other businesses, compiling easy-to-read comparative summaries that examine several key parameters in order to identify the most promising among them.

Along the way, we continually seek out strategic levers your company can use to gain a market advantage, and then we convert them into clear initiatives for fast implementation. Our Project Management Office provides you with status reports and simple dashboards so that a current evaluation of your progress is always at your fingertips.

Well-researched, comprehensive and easy to use: Our dedicated multi-level approach makes Ipsos an ideal partner for Go-to-Market in both emerging and developed markets. For more information on how you can get started on the path to market success, go to www.ipsosconsulting.com to find your nearest office.

www.ipsosconsulting.com/go-to-market

ABOUT IPSOS BUSINESS CONSULTING

Ipsos Business Consulting is the specialist consulting division of Ipsos, which is ranked third in the global research industry. With a strong presence in 88 countries, Ipsos employs more than 16,000 people.

We have the ability to conduct consulting engagements in more than 100 countries. Our team of consultants has been serving clients worldwide through our 20 consulting "hubs" since 1994. Our suite of solutions has been developed using over 20 years experience of working on winning sales and marketing strategies for developed and emerging markets. There is no substitute for first-hand knowledge when it comes to understanding an industry. We draw on the detailed industry expertise of our consultants, which has been accumulated through practical project execution.

Founded in France in 1975, Ipsos is controlled and managed by research and consulting professionals. They have built a solid Group around a multi-specialist positioning. Ipsos is listed on Eurolist - NYSE-Euronext. The company is part of the SBF 120 and the Mid-60 index and is eligible for the Deferred Settlement Service (SRD). ISIN code FR0000073298, Reuters ISOS.PA, Bloomberg IPS:FP



Build • Compete • Grow

At Ipsos Business Consulting we focus on maintaining our position as a leading provider of high quality consulting solutions for sales and marketing professionals. We deliver information, analysis and recommendations that allow our clients to make smarter decisions and to develop and implement winning market strategies.

We believe that our work is important. Security, simplicity, speed and substance applies to everything we do.

Through specialisation, we offer our clients a unique depth of knowledge and expertise. Learning from different experiences gives us perspective and inspires us to boldly call things into question, to be creative.

By nurturing a culture of collaboration and curiosity, we attract the highest calibre of people who have the ability and desire to influence and shape the future.

Our Solutions

- Go-to-Market
- Business Unit Strategy
- Competitive Intelligence
- Partner Evaluation
- Innovation Scouting
- Optimal Channel Strategy
- Market Sizing
- Pricing
- Forecasting
- Brand Strategy & Value
- Sales Detector
- B2B Customer Segmentation

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