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DRONE TECHNOLOGY FOR LAST-MILE DELIVERY IN RUSSIA: A TOOL TO DEVELOP LOCAL MARKETS

As the popularity of online shopping increases, last-mile delivery is gaining more and more attention of e-commerce companies. One of the viable solutions to maximizing the benefits of such delivery and cutting its costs is the usage of the rapidly developing drone technology. However, drone delivery is associated with a number of safety and privacy, which makes legislators uneasy about permitting the commercial use of drones. In this paper, we compare the drone regulations applied in various countries with those of Russia and analyze the criteria used to develop such regulations. Six general approaches are thus outlined: officially banning commercial drone operation; making it virtually impossible for drone operators to acquire the necessary registration and license; allowing to fly drones in exceptional cases over restricted areas; prohibiting to fly drones beyond the pilot's line of visual sight; allowing to fly drones if standard requirements are met; and, finally, following the substantial precedent principle. This analysis shows us the possible strategies Russia could adopt to regulate commercial drone usage. It is thus suggested that Russia should follow the example of Rwanda and China and allow to experiment with drone delivery in rural areas, where the risk to people's lives and property in case of drone malfunction are lower than in urban areas.

Keywords: drone technology, last-mile delivery, drone delivery, e-commerce, legal framework.

Introduction

In 2016, the on-line expenditure on physical goods on the Russian e-commerce market amounted to approximately $16.3 billion, including estimated $4.3 billion of foreign e-commerce sales, with 80% of parcels and small packages coming from China [1]. The market estimates were speculated to top $17.1 billion in 2017, according to (AKIT) Association of Online Retail Companies. In total, 360 million shipments (both domestic and cross-border) resulted in average spending of 2,500 rbs per e-shopper [2]. Online purchases and home delivery have become widely spread because they are less detrimental for the environment and require less effort on the part of the customer [3]. Together with the growing Internet sales, the growing demand in the delivery industry is also growing. The majority of online shopping companies in Russia currently rely on third parties (private carriers). The leading company is the Russian Post, which accounts for 99% of deliveries in the country due to its large postal network. There are also such services as DPD, SDEK, SPSR-Express, Pony Express and IML Courier [2] whereas some companies offer their own delivery to the customer's location without any third-parties involved.

Figure 1 shows a forecast for retail e-commerce sales in Russia for the period from 2015 to 2018. There is a gradual increase in sales, which are expected to reach 30.91 billion U.S. dollars by the end of 2018.

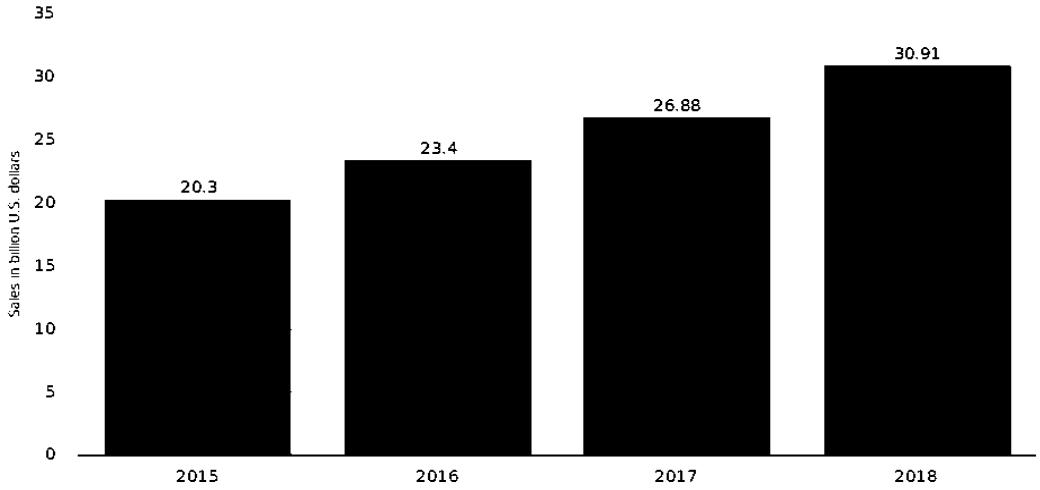

Fig. 1. Forecast retail e-commerce sales in Russia from 2015 to 2018[1]

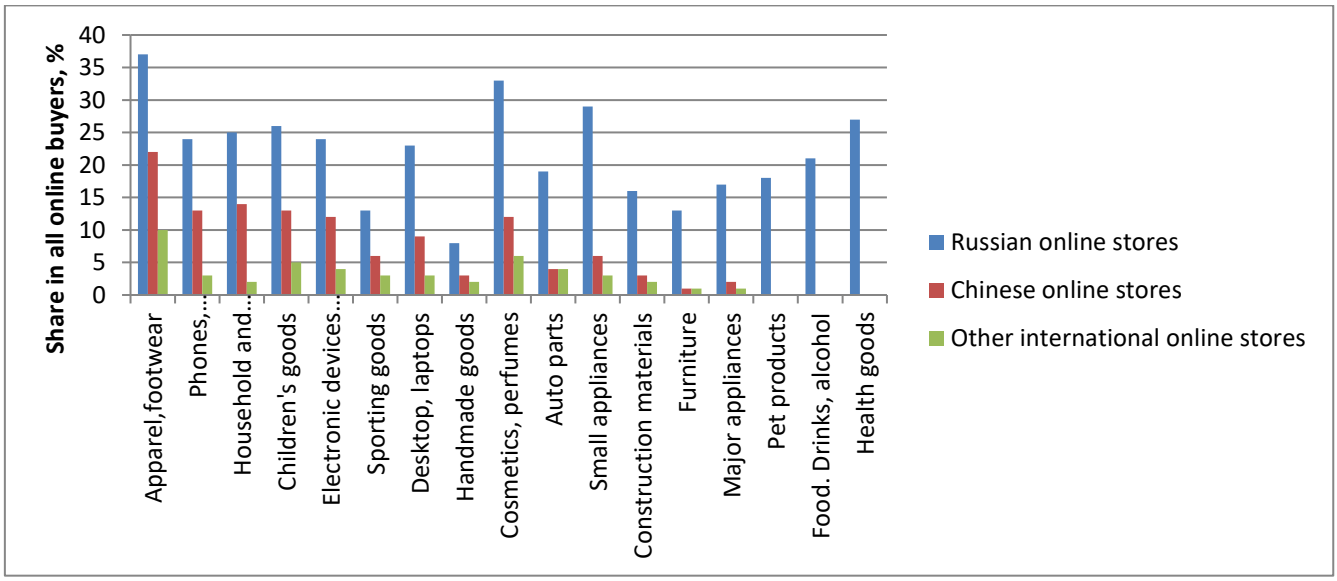

Fig. 2. Types of goods purchased from different online stores in 2016 in Russia[2]

Figure 2 demonstrates various types of goods purchased from different online stores in 2016. It is evident that Russian online stores, like Ulmart.ru, Wildberries.ru, Mvideo.ru, AliExpress.ru and Avito.ru, surpassed their counterparts with a share of over 35% as a result of Russian customers' preference of Chinese and foreign on-line stores. Most of the goods were comparatively light and, therefore, could be effectively delivered by a drone. As a rule, carriers serving on-line shopping web-sites have to deliver one or several small packages to the customer's address [4]. The new, increasingly popular strategy is to ship products directly from the seller to the customer by skipping drop-offs at retail stores [5]. Comparison between online and conventional shopping has been the core focus of most previous papers concentrating on the grocery retail sector[6]. In the traditional shopping supply chain, goods are delivered to a store for customers to pick them up. Typically, the process of

[1] Source: e-Marketer, Statista 2017

[2] Source: GFK RUS and Yandex market data , 2016.

online shopping consists of three stages: placing an order, processing the order and delivery. Each of these stages is vital for ensuring effective customer services at the expense of potential customers [7]. Considering all the phases, starting from the order being placed to home delivery by the seller, logistics providers and transportation companies have found that last-mile delivery to be not only complicated but also expensive [8]. Concerns have been expressed about the rapid growth of home deliveries and their efficiency, which might diminish the net benefits from online shopping [9]. In this study, we are going to focus on the third stage, order delivery.

Last-mile delivery

In logistics, last-mile delivery refers to delivering a customer's order to his or her doorstep [10]. Logistics providers [11] face different challenges, including the following:

- traffic congestions in downtown areas;
- environmental issues caused by inefficient routes in rural areas;
- increased delivery costs;
- as customers are now more prone to purchasing small quantities of goods, cases of failed deliveries (orders are delivered when no one is at home) have become more frequent as well as the return of unwanted goods [12].

In the traditional shopping system, customers are responsible for picking up their orders and bringing them home, whereas in online shopping, most of the work is done by retailers, who deliver customers' orders to their respective addresses sometimes within relatively short time slots [4].

Trying to address the above-described issues, carriers may resort to such options as collaborative delivery, like Colis-voiturage for heavy shipments. Moreover, Amazon is preparing to launch an Uber-style system[3] for road transport. There has recently been an increase in the usage of self-employed couriers [4]. The major online retailers now rely on third-party courier networks such as the Russian Post [2]. Other alternatives include drones (JD.com[4]), autonomous robots (Swiss Post), green deliveries by boat, e-bikes[5] or on foot deliveries and electric buses (wholesale brand Métro). Sainsbury is planning to switch to electric vans for its on-line shopping delivery by 2010 [13].

The drone technology, which is able to traverse difficult terrains, reduce labour costs and replace fleets of vehicles, proves to be a viable option [14]. It is recommended as one of the best possible solution to the challenges faced by the companies providing last-mile delivery. The drone technology has the potential to significantly reduce the delivery costs and save time required to deliver packages. Moreover, drones are less expensive to maintain, they are not limited by the established infrastructure, such as roads, and generally involve less complex obstacle avoidance scenarios as compared to the traditional delivery vehicles such as trucks [15]. There is an opinion that since drones do not need to make frequent stops on the way, they will provide an even faster direct service [16, 17]. This way, packages will no longer have to be individually delivered to customers by couriers. This idea is so alluring that large companies have embarked on developing and testing delivery models considering all the safety precautions in order to obtain permits to use drones for last-mile delivery.

International experience of drone delivery

The twenty-first century has witnessed an advancement of drone technology and a number of major companies have engaged in drone testing [18]. In 2012, Silcon Valley startup Tacopter [19] made headlines when it publicly announced its plans to launch a delivery service of tacos within the city of San Francisco via unmanned aerial vehicles (UAVs). In 2013, Amazon [20] claimed that it was designing a drone delivery program

[3] Postal Record, 2017. Delivery by Uber?
[4] Josh Gartner, 2017. Drone Delivery program Fact Sheet.
[5] Somit Sen, 2017. Maharashtra to push for e-bikes for delivery of food, goods.

called 'Prime Air' to deliver packages within just thirty minutes. In September 2016, an American based logistics company UPS [19] tested a medical supply drop to an island off the coast of Massachusetts; the same month, as a part of Alphabet Inc's drone delivery initiative, burritos were sent to students of Virginia Tech. In 2013, Deutsche Post DHL [22], a logistics company in Germany, also started its Parcelcopter project. In March 2016, the largest convenience chain 7-Eleven [23] and a drone startup Flirtey made a drone delivery in Reno, Nevada, which was the first such delivery to be approved by the aviation authorities (FAA). In April 2016, a Japanese e-commerce giant Rakuten[6] tested its drone on the golf course where players were able to use their phones to request new golf balls or refreshments to be delivered to them.

In November 2016, Flirtey and Domino's Pizza Enterprises Ltd [7] delivered pizzas from Domino's stores to customer homes in New Zealand as a part of Enterprise's ongoing drone delivery testing. Since mid-March 2017, Swiss Post [24] has successfully been conducting drone flights in Lugano, testing the transportation of laboratory samples between two Ticino hospitals. In Russia, in June 2014, Dodo Pizza[8] became the first company to make a trial deployment of a drone in last-mile delivery. In June 2017, one of Russia's major banks Sberbank[9], successfully tested cash delivery from their cash handling center to a cash-in-transit van.

Table 1.

Applications of the drone technology by market category[10]

Asset management	**Aerial surveying**	**Cinematography**	**Video marketing**	**Other**
Power line inspections	Forestry management	Films	Real estate	Fire scene inspections
Railway line inspections	Geophysical surveys	Documentaries	Tourism destinations	Insurance claims
Oil pipeline inspections	Land use planning	News	Property development	Crash scene inspections
Wind turbine inspections	Mapping	Sporting events	commercials	Monitoring marine wildlife
				Agriculture
				Anti-piracy operations
				Border controls
				Flood documentation
				Research

The table above shows that the drone technology has a wide range of applications, some of which are still waiting to be realized.

[6] Reuters. (April 26,2016). Japan's Rakuten Demonstrates "First Commercial Drone Delivery Service in the World" Access mode: http://toyokeizai.net/articles/-/115632

[7] Flirtey. (Nov 15, 2016). Flirtey Launches World's First Pizza-By-Drone Commercial Trials, Delivers Domino's Pizza to Customer Homes.

[8] LENTA.RU. (June 25, 2014). Dial-a-drone! Syktyvkar pizzeria begins unmanned deliveries.

[9] Sputnik news. (June 16, 2017). Access mode: https://sputniknews.com/science/201706161054695960-russia-sberbank-drone/

[10] Source: Rich, C. (2015).

Legalization of drone delivery in Russia

Despite the struggle to develop the drone technology models for commercial use, companies cannot proceed without permission from the corresponding regulatory bodies [23]. The questions to be addressed in this respect are as follows: should the technology be permitted at all? Should society permit the development of such a technology, which is likely to threaten people's privacy? If the development of this technology is unstoppable, should there be a regulatory framework so that only authorized individuals or legal entities could use it for socially acceptable purposes? [25]. Let us now compare the existing legal framework in Russia with those of other countries.

In order to decide on the legal framework to regulate drone use we need to consider the fact that drones can be used for criminal ends, for example, to smuggle weapons and drugs or as a weapon. Moreover, there is a number of privacy issues associated with drones as they can carry video equipment and thus can be used for illegal surveillance. It is also essential to decide who should be authorized to operate drones as it requires certain skill and experience while drones can be dangerous to people and objects in their vicinity.

Commercial drone regulations are different in various countries, which either choose to benefit from the development of this technology or to restrict it for safety reasons [25]. Legal regulators around the world are toiling to keep up with the rapidly evolving technology with unlimited capabilities which may be perceived as threatetning the traditional norms and values [27].

There are six main parameters commonly used as standards for drone regulation at the national level: maximum altitude; VLOS and BVLOS flights; licensing; flying drones at night time or in bad weather; pilot certification; and drone banned zones.

Table 2.

Laws regulating the use of commercial drones in different countries

Features	**Australia**[11]	**Canada**[12]	**UK**[13]	**China**[14]	**New Zealand**[15]	**USA**[16]	**Russia**[17]
Regulatory body	Civil Aviation Safety Authority (CASA)	Transport Canada (TC)	Civil Aviation Authority (CAA)	Civil Aviation Administration of China (CAAC)	Civil Aviation Authority of New Zealand (NZCAA)	Federal Aviation Administration (FAA)	The Federal Air Transport Agency (FATA)
Maximum altitude	Controlled airspace - 120m / 400ft -Outside - No limit	Max. 300ft	Max. 120m / 400ft > 120m / 400ft approval required	Max. 120m / 400ft > 120m / 400ft approval (CAAC)	Max. 120m / 400ft > 120m / 400ft approval required	121m / 400ft	Not specified

[11] Australia UAV. Access mode: https://www.casa.gov.au/operations/standard-page/how-become-safe-rpa operator?wcms%3astandard%3a%3apc=pc_101985

[12] Transport Canada - drone safety. Access mode: http://www.tc.gc.ca/eng/civilaviation/standards/general-recavi-uav-2265.htm?wt.mc_id=1zfhj#safety

[13] Civil Aviation Authority - cap393. Access mode:http://publicapps.caa.co.uk/docs/33/cap%20393_aug2016.pdf

[14] China's new drone regulations. Access mode: http://www.caac.gov.cn/index.html

[15] CAA of Newzealand. Access mode: https://www.caa.govt.nz/rules/rule_consolidations/part_101_consolidation.pdf

[16] FAA drone regulations. Access mode: http://www.faa.gov/uas/media/part_107_summary.pdf

[17] Federal Air Transport Authority. Access mode: http://www.favt.ru

Maximum take-off weight	< 2kg / 4.4lbs > 2kg / 4.4lbs	< 25kg / 55lbs > 25kg / 55lbs permission required	Not specified	0≤1.5kg, 1.5≤4kg, 1.5≤7kg, 7≤25kg, 15≤116kg, 25≤150kg >5,700kg (agricultural)	25kg / 55lbs	< 25kg / 55lbs > 25kg / 55lbs permission required	30kg / 66lbs
BVLOS flights	Not allowed		Not allowed	Not allowed	Not allowed	Not allowed	Not allowed
Competence statement / license	< 2kg / 4.4 lbs = Registration required > 2kg /4.4lbs = Operators certificate + RPA required Commercial flight- 5 days notice.	>1kg ≤25kg Required (Urban)	>20kg-≤150kg CAA license required	<250 g/.55lbs - Real name registration >7kg/15lbs-<116kg (CAAC) license	Not required	>0.55lbs Required	<30kg- Not required >30kg - Required
Night time and bad weather	Special approval	Not allowed	Special approval	Special approval	Special approval	Special approval	Not allowed and a watcher required
Labeling requirements	Not required but recommended	Not required	Not required but recommended	Not required	Not required	Required	Required
Air traffic control notification	Required in controlled airspace	>4lbs - Required	> 15lbs - Required in controlled airspace	Required	Required in controlled airspace		Required
Drone liability insurance	Not required but recommended	Required, $100,000	Not required but highly recommended	Not required	Not required	Not required but recommended	Required
Pilot	<4lbs None	Above 18	Training	<116kg,	Knowledge	Above 16	Required

certification	>4lbs Requires manufacturer conducted training course	years of age -Ground school	(commercial)/ basic certificate for UAS and ground school	required	of airspace restrictions	years of age	
Drone ban zones	-State institutes -Federal authority constructions -Regional authority constructions -Airport control zones (CTR) -Vehicles, Boats, Buildings, People Hospitals -Operation sites of police, military, search- and rescue forces	-State institutes -Federal authority constructions -Regional authority constructions -9km from Airport control zones (CTR) -Minimum 150m/500ft from crowds and 90m from built up areas hospitals -Operation sites of police, military, search and rescue forces	-State institutes -Federal authority constructions -Regional authority constructions -Airport control zones (CTR) -Minimum 150m/500ft from crowds and built up areas hospitals -Operation sites of police, military, search and rescue forces	-State institutes -Federal authority constructions -Regional authority constructions -Airport control zones (CTR) -Crowds of people Hospitals -Operation sites of police, military, search- and rescue forces *DJI drones- programmed not to take off in No-fly zones.	-State institutes -Federal authority constructions -Regional authority constructions Airport control zones (CTR) National Parks Crowds Private Property (only with permission of the owner) Hospitals -Operation sites of police, military, search- and rescue forces	-State institutes; Washington -Federal authority constructions -Regional authority constructions -Airport control zones (CTR) -Crowds of people (not specified) Hospitals -Operation sites of police, military, search- and rescue forces	-State institutes; Moscow kremlin, Red Square -Federal authority constructions -Regional authority constructions -Airport control zones (CTR) -Crowds of people - military installations, power plants

As we can see, all countries have bodies regulating drone operation. The requirements differ depending on drone capability, payload, mass, altitude, application, operator's license level and flight area. Operation of drones beyond the visual line of sight (BVLOS flights) is not allowed in most countries and it is accompanied by a set of requirements concerning the maximum altitude and the restricted distance from a crowd of people. Labeling is an optional requirement in many countries but it is obligatory in Russia.

To use recreational drones no license, insurance, registration or certification is required. The rules are much stricter regarding commercial drone applications: for example, the air traffic control notification is required in all countries; flights are either banned or highly restricted in certain areas, for example, airport

control zones, state institutions, power plants and so on. Flying drones at night or in bad weather conditions also usually requires a special permission whereas in Russia it is prohibited and requires presence of a watcher.

Thus, Russian drone laws are very much in line with those of other countries, with only a few exceptions:

- drone operators must have a watcher at all times to monitor the flight and drones must not be operated beyond the visual line of sight;
- the air traffic control must be notified prior to the flight with a detailed flight plan to be provided (in other countries, it is only required in controlled airspaces);
- a drone has to be labeled for the purpose of identification;
- at the moment, no maximum flight altitude is specified but this issue will undoubtedly soon be addressed and limits will be set.

There are six general approaches [27] to national commercial drone regulation varying across countries:

1. Outright ban: countries that prohibit any commercial drone operation (for example, Morocco, Argentina, and Cuba);
2. Effective ban: countries that officially allow commercial drone application but the licensing and registration procedures make it virtually impossible to obtain a legal permission (for example, Algeria, Belarus, and Egypt);
3. Drones must not be operated beyond the visual line of sight, which limits the potential of drone usage (for example, Belgium, Croatia, and Thailand);
4. Permission can be given in exceptional cases to carry out drone testing within restricted areas (for example, Brazil, Canada, and Germany);
5. Commercial drone operation is permitted as long as the standard requirements (registration, licensing, and insurance) are met (for example, Sweden, Norway, and Iceland);
6. Substantial precedents: these countries follow the substantial precedent principle regarding drone regulations and monitor the results of the strategies adopted by other countries.

Conclusion

As we have shown above, the development of last-mile delivery is currently facing a series of challenges, which can be met with the help of drones. However, in many countries, including Russia, drone delivery is prohibited. In Russia, a drone must not be operated beyond the visual line of sight, which considerably limits the possibilities of using drones for last-minute delivery. Moreover, the air traffic control must be notified prior to any flight.

A more productive approach would be to develop regulations to enable society benefit from the drone technology and at the same time to ensure safe usage of drones and protect people's privacy. In such countries as Rwanda and China, drone operation is permitted beyond the pilot's visual line of sight, which enhances the development of drone delivery (Rwanda was the first country to permit commercial drone delivery in the world). Although legal regulators in both countries have issued a green pass to drone delivery, there are still strict restrictions to be met, for example, deliveries must only be carried out in rural, not densely populated areas. This is done to reduce the risk level in case of any drone malfunction. Drone laws in Russia and other countries are being constantly amended and, in general, the governments seek to broaden the specter of opportunities for commercial drone delivery. The approach adopted in Rwanda and China, that is, the usage of drones for delivery in rural areas, might prove to be quite effective in Russia as well. What Russian legislators could start with is, for instance, permitting experiments with drone delivery in the countryside since the risk level in such areas is low.

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