Disruptive Innovation – A Study on the Interplay between Policy & the Commercialization of Drone (UAV) Technologies

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Abstract

Integrating insights from global governance, technology policy, and disruptive innovation, this paper seeks to utilize the example of commercial drone technologies to illustrate how discussions on entrepreneurship have evolved in recent years. With references to three indicative case studies in the commercial drones sector, this paper argues that a conducive policy environment is critical in the successful commercialization of emerging and future technologies. It argues that in the case of commercial drone technologies, the lack of such a policy environment constitutes a major inhibitor of the technology's global proliferation and commercialization. The paper will draw on Christensen, Raynor, and McDonald's work on disruptive innovation (2015) in shedding light on the intricate interplay between new technologies, commercialization, and innovation policy. Analyzing and comparing policy environments, this paper asserts that companies that originally produced low-performing commercial drones have now moved to disrupt the Intelligence, Surveillance, and Reconnaissance (ISR) equipment market.

Background

As the global economy strives to recover from the pandemic and its associated disruptions (e.g. major supply chain issues), the innovation and entrepreneurial community continue to turn to technologies for growth. As volatile geopolitical developments put mounting pressure on energy supply, inflation rate across the globe rises. In the UK, the Bank of England cautioned that inflation could reach 11% towards the end of 2022. This increase is projected in spite of adjustment of interest rate to 1.25% (Jordan, 2022). Such a high inflation rate suggests that both established and emerging organizations would be under enormous pressure to re-evaluate its innovation portfolio and strategy, as safer, more modest returns brought by incremental innovation (Nagji and Tuff, 2012) no longer brings the same level of appeal and economic viability.

Many established companies, such as Facebook and Amazon, now turn to what Nagji and Tuff (2012) called adjacent and transformational areas of innovation. They look to step outside of the comfort zone of their core businesses, and venture into emerging, perhaps even uncharted areas and markets. For example, Facebook/Meta has reoriented to focus on Virtual Reality (VR) innovation and technologies. In similar light, Amazon has been proactive in exploring developments in its cloud services offering, potentially with it's transformational investment in Project Kuiper – the launch of mega satellite constellation that could bring ubiquitous connectivity.

At the same time, latest appointments at Facebook/Meta and Amazon reflect a growing awareness of the role that policy plays in the commercialization of new technologies. Both Facebook and Amazon had turned to professionals with a policy background for senior positions in recent years. Nick Clegg – the former Deputy Prime Minister of the UK and former leader of the Liberal Democrats – took up the role as Facebook's (now Meta) Vice President of Global Affairs (Sweney, 2018). Similarly, former White House advisor – Peter Marquez – was appointed to become Amazon's first Head of Space Policy for its Web Services (Chowdhury, 2020). These positions were previously most frequently filled by professionals with a background in Law.

Latest appointments discussed above coincide with the call for focus on technology policy, both at the organizational, national, and international level, in ensuring successful commercialization of innovation and new technologies, as well as for the long-term sustainability of the company.

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on entrepreneurship have evolved in recent years. With references to three indicative case studies in the commercial drones sector, this paper argues that a conducive policy environment is now critical in the successful commercialization of emerging and future technologies. In the case of commercial drone technologies, the lack of such a policy environment constitutes a major inhibitor of the technology's global proliferation and commercialization. Drawing on Christensen, Raynor, and McDonald's work on disruptive innovation (2015), the paper seeks to shed light on the intricate interplay between new technologies, commercialization, and innovation policy. Analyzing and comparing policy environments in relation to commercial drone technologies, this paper asserts that companies that originally produced low-performing commercial drones have now moved to disrupt the Intelligence, Surveillance, and Reconnaissance (ISR) equipment market.

Methodology and Case Selection

In studying how policy affects the commercialization of new technologies, this paper will examine three indicative cases in the commercial drones sector, namely, the commercialization of micro toy drones, drones-as-a-service, and the industry's dominant manufacturer – DJI. Together, these cases represent major business models and clientele in the commercial drones industry, and thus paint a picture of how policy poses challenges to the sector across the spectrum, from companies catering to the lower-end toy drones market, to those who offer a more specialist service of operating drones for surveying and inspection.

The commercial drones industry was chosen as a significant case of emerging and future technologies for study. The sector constitutes a major domain of entrepreneurship in recent years. The industry had witnessed a period of intense attention and investment. In 2015, it was estimated that almost 90% of venture capital (VC) was invested into new drone companies in the US. In other words, almost every major VC has at least one commercial drone company in its portfolio. A Goldman Sachs report (Goldman Sachs, 2015) further asserted that the drone industry was set to expand to a $100 billion market in 5 years time. The VC and business sector envisioned that we were to see drones flying around in civilian airspace, delivering time-critical medical supplies and organ for transplants, as well as our daily takeaway and amazon orders.

Understanding Entrepreneurship

One of the earliest definitions of entrepreneurship conceptualized it as the pursuit of opportunity beyond the resources that one currently controls. (Stevenson and Jarillo, 1990) And as late as in 2013, expanding on this definition, Tom Eisenmann argued in *Harvard Business Review* that the biggest challenge for entrepreneurs is to mitigate four major risks in the following areas (Eisenmann, 2013):

1. **Demand** – associated with prospective customers' willingness to adopt the solution
2. **Technology** – associated with the engineering & scientific breakthroughs are required to bring about a solution
3. **Execution** – associated with the ability to attract employees and partners to implement the venture
4. **Financing** – associated with securing available external capital (Eisenmann, 2013)

The Entrepreneurial Landscape of Commercial Drones (UAV) Technologies

For commercial drones, huge demands were envisioned at the onset of Covid lockdowns, as the technology could potentially fill a critical service gap when our mobility became severely restricted. However, as economies geared for a post-pandemic economy, commercial drones are still yet to proliferate in civilian airspace. Venture capitalists (VCs) and drones entrepreneurs alike were all very puzzled: Why had drones technologies not fully commercialized? The risks in the four areas identified by Eisenmann should have been manageable. First, there were demands, especially during the pandemic; second, unmanned aerial vehicle (UAV) technologies are comparatively mature, with many developments reaching a high Technology Readiness Level (ie. TRL7-8) (Ivanova and Gallasch, 2016); third, there were considerable finances, resources, and talents to

further advance the technologies, as witnessed by interests from VCs and the proliferation of start-ups in the commercial drones sector. Risks in demand, technology, execution, and financing aspects thus were all mitigated, and yet the technology had not fully taken off.

POLICY – The missing factor in enabling the commercialization of emerging technologies

This paper argues that it is the lack of an enabling policy environment, as well as the lack of awareness of how policy plays a part in a technology's proliferation, that inhibited the full commercialization of drones technologies in recent years.

The following indicative cases highlight scenarios when policies directly/indirectly enabled or inhibited the commercialization of consumer drones technologies.

Case Study 1

Micro-drones & Battery Shipping Regulations

A UK company specializing in micro toy drones voiced frustration about shipping policy in relation to posting lithium battery. Current models of micro-drones have a battery life of approximately eight minutes. Although there can be further technological advances in extending battery life, professionals in the sector generally don't consider technology to be the most inhibiting factor in commercialization. Rather, many found that limitations surrounding shipping batteries had greatly restricted potential growth in the micro/nano-drones sector. Current international norms and regulations in shipping, export, and import limit lithium battery shipments to one per parcel. For ventures that seek to advance B2C sales, this poses significant barriers for micro-drones SMEs to scale up or expand their businesses. (Centre for Technology and Global Affairs, 2018, p. 9)

Case Study 2

Drones-as-a-Service and Policy on Beyond-Visual-Line-of-Sight (BVLOS) Operations

In the US, the Federal Aviation Administration (FAA) stipulates that the aerial inspection of each wind turbine would require the presence of two inspectors - one drone pilot and one visual observer. This regulation essentially bans commercial drones from operating beyond-visual-line-of-sight (BVLOS), which many consider essential in drones-enabled inspection of critical infrastructure (e.g. wind turbines). As the inspection of one wind turbine requires two professionally trained personnel, this restriction posed enormous challenges for drones-as-a-services companies to scale up their operations. (Centre for Technology and Global Affairs, 2018, p. 3)

Case Study 3

DJI – the dominant drones manufacturer - and Disruptive Innovation

While policies in developed economies (e.g. UK, US) can be more thorough and stringent, regions with more accommodating policy environment witnessed rapid prototyping, testing, and development of commercial UAV. Companies in more enabling policy environment were then able to introduce different models, catering to different segments of the market. DJI, the current market leader with headquarter in Shenzhen, has products ranging from its more accessible MAVIC model, to its heavy-lifted MATRICE model that can be used with a LiDAR (light detection and ranging laser technology) camera. DJI now dominated 94% of the consumer drone market. (Dukowitz, 2021) Previous market players, such as GoPro from the US and Parrot from France, have faded in comparison as DJI moved to increase its market shares.

DJI also proved to be a major disruptor to the Intelligence, Surveillance, and Reconnaissance (ISR) equipment market – a market that the US, noted for its leadership in producing high-precision drones, originally dominated. For example, DJI's MATRICE 300 and 600 are now known to be used by law enforcement authorities in *both* developing and developed countries. The Devon and Cornwall Police, for instance, employs a fleet of 35 DJI drones. (Laperchia, 2021; Devon & Cornwall Police, 2019)

In 2015, Christensen et al. elaborated on the proposed concept of disruptive innovation, arguing that disruption occurs when "a smaller company with fewer resources is able to successfully challenge established incumbent business." (Christensen et al., 2015) The rationale being that, as established incumbents focus on improving quality of their products or services, they move to cater for higher-end segment of customers, neglecting the lower-end of the market.

This seems to reflect the US' loss of leadership in both the consumer and ISR drones markets.The military and ISR equipment sector originally might not be concerned with the emergence of commercial drones company (e.g. DJI), as these companies were seen to be producing sub-optimal or lower performing consumer drones that could not meet the demands for ISR operations. Initially, there were limited reasons for the US, who already possessed the savoir-faire in producing high-precision and high performing drones (e.g. Predator and the Reaper), to dedicate significant R&D to producing cheap and low performing drones that cannot be used for ISR purposes. At the same time, the confidential aspect of the military-industrial complex of the defence sector suggested that commercial drones ideas cannot be easily released, making it difficult for civilian use cases to be developed.

Moreover, the stringent policy environment, as demonstrated in FAA regulation discussed earlier, rendered it challenging for the commercial drones sector to prototype, test, and scale in the US. In turn, other regions were able to mature their commercial drones technologies in a more conducive environment. Companies that originally produced low-performing models, were then able to manufacture more sophisticated versions. Subsequently, they advanced to challenge US leadership in the ISR industry.

Conclusion

As organizations increasingly turn to adjacent and transformational innovation for growth amidst high inflation, policy has become a key factor in enabling commercialization of new technologies. Cases from the commercial drones sector reflect that policy now constitutes a *bona fide* area of risks that must be addressed. While major technology giants (e.g. SpaceX, Meta, Amazon) have the resources and foresight to anticipate this shift, entrepreneurs of smaller scale companies cannot neglect burgeoning developments in technology policy if they want to remain competitive. At the same time, incumbent market leaders should take heed of the potential of disruptive innovation. The rise of DJI is not only a lesson of success in innovating with limited resources, it is also a lesson of failure of market leader in ensuring a conducive environment for sustainable growth and open innovation.

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