

THE APPLICATION OF UNMANNED AERIAL VEHICLES IN MANAGING PORT SECURITY IN KUWAIT

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Abstract

Purpose: This paper carries out an investigation into the use of unmanned aerial vehicles (UAVs), also known as drones, in border security and their ability to enhance existing security measures in Kuwait's ports. Considering UAVs are currently deployed by the military as well as by private companies and individuals throughout the world, including Kuwait, very little scholarly work has addressed the use of UAVs in advancing port security. The purpose of this paper is to appraise the advantages and disadvantages of UAVs in the context of improving Kuwait's port security.

Research Approach: The main research question proposed is how can UAVs be effectively utilised to enhance port security? Both primary and secondary data were collected. The primary data collection involved both qualitative and quantitative methods. Primary data was collected using an online survey issued to 66 port-related respondents and from five semi-structured telephone interviews, with a subset of the survey respondents.

Findings and Originality: The primary data analysis revealed that port officials are aware that UAV technologies can bring a significant improvement to their security. Still, there are risks associated with the implementation of such a system, especially concerning the threat of terrorist organisations and cyber security. Therefore, it was concluded that, for the successful implementation of this technology in port security, a proper framework needs to be set in place. Recommendations for this framework are proposed in this research. The interview findings further explain the current security concerns of ports, the manner in which UAVs can contribute to port security and the associated risks, and formulate a series of recommendations concerning these risks. The respondents unanimously agreed to the registration system of all UAV users, similar to motor vehicle licence plates, indicating a higher level of control could diminish the risk of unauthorised aerial breaches of port security using drones.

Research Impact: The research addresses a significant gap in the literature on the deployment of an emergent technology in ports for the purposes of surveillance in advancement of both safety and security.

Practical Impact: The study contributes to practice by making the following recommendations: introduce the use of UAVs to enhance port security, especially for monitoring and surveillance purposes; ensure pilots are certified with the Basic National (Unmanned Aerial Systems) Certificate for small Unmanned Aircraft (BNUC-S); introduce a system whereby all UAV flights, their pilots and training are recorded on a central data management system, such as synergia's airfleetmanager; improve legislation regarding port security in order to encompass cases of cyber security and information sharing security, acknowledging the risks and provide recommendations for their reduction; include a focus on port security in the main cyber security frameworks and make governmental bodies accountable for port security.

Keywords: unmanned aerial vehicle; drone; port security; ISPS Code

Topics: port security; maritime security; surveillance

Introduction

Unmanned Aerial Vehicles (UAVs) also known as drones have proliferated since the improvements in the weight and power of batteries and electric motors. UAVs are now common among hobbyists as well as in use by commercial organisations involved in survey work as well as film and photography. UAVs are now beginning to be deployed more in the monitoring of safety and security and this study aims to reveal the extent to which UAVs can be deployed to enhance security, but with a focus on maritime ports.

Literature Review

Types of UAV

There are numerous types of UAVs and drones currently in operation. From nanodrones, microdrones and minidrones, which are widely available for purchase by civilians, to small range and long-range medium altitude and long endurance (MALE) and high altitude and long endurance (HALE) drones, which are typically employed by military forces. All these vehicles have some similarities, such as the lack of humans aboard them and the ability to be controlled via radio/infrared communication. The ranges, weights, payloads and altitudes of these vehicles also vary. In terms of altitude, they can fly between heights of 30 metres and over 10 km. In terms of endurance, their power units offer flight times of between 12 minutes and over 24 hours. In terms of payload, their maximum take-off weight ranges between 0.4 kg and more than 3 tons (Dougherty, 2015).

Talas (2016) states that the current regulations that exist for the commercial flying of UAVs differ from nation to nation. The regulations for the commercial flying of UAVs in the UK are governed by the Civil Aviation Authority's (CAA) *Unmanned Aircraft System Operations in UK Airspace: Guidance* (March 2015). The guidance, also known as CAP722 states that UAVs operating in the UK must meet at least the same safety and operational standards as manned aircraft. UAVs are classified into three categories: those which weigh up to 20kg; those which weigh between 20kg and 150kg; and those which weigh more than 150kg.

In the UK, drone hobbyists are not required to register their UAVs and nor do they need operating permission from the CAA or a pilot qualification. Furthermore, drones must not be flown within 50 metres of people or over or within 150 metres of any congested area or of an organised open-air assembly of more than 1000 persons. The drone must be flown in visual line of sight so that direct, unaided visual contact can be maintained with the aircraft which is sufficient to monitor its flightpath in relation to other aircraft and persons on the ground. The drone must remain within 500 metres horizontally and no more than 400 feet vertically from the operator. If a drone operator wishes to fly within 50 metres of people or 150 metres of a congested area then prior permission must be obtained from the CAA. Similarly, for all commercial UAV flights the CAP 722 regulation states that permission must be obtained from the CAA prior to any flight (Talas, 2016). Where UAVs are deployed for commercial purposes, it is necessary for the pilot to have undergone training for at least the basic national UAS certificate for small unmanned aircraft (UAV Academy, 2016).

In a port, a UAV could be deployed on regular perimeter checks to assess any fence-line breaches or to overfly buildings to check that roof access doors have not been left open. Furthermore, checks can be made from the air on any restricted areas in the event of the failure of another detection system, such as CCTV cameras.

Classification of UAVs in Terms of Autonomy

In order to determine what the best choice of UAV technology would be for the purpose of ensuring port surveillance, it is necessary to examine the existing technology in terms of autonomy. Huang

(2010) describes how the levels of autonomy are categorised from zero (UAVs devoid of any autonomy) to 10 (fully autonomous UAVs). The evaluation in this study will be constructed around the needs of the port supervision authorities and counter-terrorist forces as well as around the financial and technological resources available in Gulf countries. Higher degrees of autonomy might be not only more expensive, but also unnecessary for the tasks implied in port supervision. This means that first, it is necessary to establish the tasks and activities for which UAVs are required and what type of vehicles and systems are best suited to these tasks. Secondly, the possibilities posed by individual technologies have to be evaluated, in order to determine all the goals that a type of vehicle/technology can be selected for.

Port Security Threats

Researchers (Pinto and Talley, 2006) indicate a series of threats currently associated with US ports' security among which they mention: containers with smuggled nuclear and chemical weapons, mines placed on ships that can disrupt the use of shipping channels and pirate vessels that can be set to destroy bridges or other important landmarks. Parfomak and Fritelly (2007) add examples to Pinto and Talley's list (2006) thus proving that there is a large range of potential risks to be considered. Due to this consideration, these threats and the increased probability associated with their incidence are constantly scrutinised by specialist marine war and terrorism underwriters, who evaluate these risks as well as the costs associated with them. Talas (2010), another researcher interested in identifying the different type of security incidents associated with ports, elaborated on a list of potential security incidents, drawing on the suggestions formulated by Parfomak and Fritelly (2007). The fact that these potential incidents are similar for different port facilities indicates that they represent realistic potential threats for all ports across the world. The list compiled by Talas (2010) encompasses: bombs introduced by a person on foot, by a car, or by a truck; an attack with a biological agent directed at the port conducted either on foot or by vehicle, mining of the port infrastructure and attack by suicide vessels.

Talas (2010) points out that before the 9/11 incident the most important port security threats were considered those related to organised crime and drug smuggling. However, since September 2001, terrorist attacks have become the main concern when it comes to security risks associated with ports (Talas, 2010). Raymond (2006) indicated that these facilities are characterised by features that make them particularly vulnerable to terrorist attacks, pointing out their considerable extent and the fact that ports can be easily reached both by sea and by land. These access options make it difficult for them to be protected by the same security measures as those corresponding to airports. Further security-related vulnerabilities are described by Bichou (2004): ports' interaction with cities and tourist attractions.

Researchers have considered (Nincic, 2005) terrorist groups which are known to display different levels of maritime expertise. While these should not be ignored, neither should be the observation made by Raymond (2006) according to which port security threats should not be reduced to those potentially posed by groups who have already conducted maritime terrorist attacks. Talas (2010) argues that port security risks can also be associated with the security labour force (i.e. manpower shortfalls and security guard violations such as unauthorised copying and distribution of security passes) and to operational aspects corresponding to security systems (i.e. IT systems, CCTV camera unit failings, alien detection of scanning devices etc.). The failure of existing security systems or other existing vulnerabilities must also be included on the list of port security risks (Juttner et al, 2003). One relevant example in this respect is that of the suspected al-Qa'eda member who was transported in a container to an Italian port (Raymond, 2006).

Potential to Be Exploited by Terrorist Organisations

The constantly growing market in commercial UAVs raises concern among specialists (Dedrone, 2016) who perceive the increased risk posed to security. The fact that UAVs are largely available for virtually anyone increases the possibilities for them to be misused for reconnaissance and surveillance missions underpinned by criminal intentions. The level of development which permits these devices to carry elaborate imaging equipment and consistent payloads generates additional reasons for concern. The price of this equipment is another feature which renders them highly available for the general public. Moreover, it is highly probable that the rapid expansion of the market will push the prices to decrease even further. Specialists in the field (Synergia, 2016) point out that there are already UAVs available for under €900 that can transport a payload of approximately 1 kg, that can fly for at least 5 km, and that have full GPS. If the UAVs are equipped with both GPS systems and autopilot, then they can be used to fly independently according to pre-established routes.

According to Synergia (2016) the following categories can be mentioned as representing some of the security risks generated by UAVs:

- Reconnaissance and surveillance – UAVs could be used to identify potential targets or to conduct surveillance missions to inform their operator of the actions undertaken by different individuals from private, public or military establishments. The increased number of civil UAVs purchased by the general population makes it difficult to rapidly establish whether such a device is operated for recreational use, in order to support news-gathering and other similar activities, or if it serves criminal intentions.
- Smuggling – since UAV models are created so as to permit them to carry significant payloads, one of the existing concerns is that these vehicles could be used for the transportation of illicit goods. There have been events which motivate these concerns; most of them intended to introduce different materials into prisons (Russon, 2013, Mullany, 2015) or to transport drugs across borders (Berger, 2015).
- Kinetic attack – this type of threat is also related to UAVs' ability to carry a payload. The nature of the payload correlated with the intentions of those operating the vehicles determines the nature of the risk they pose. If the payload is made up of guns or explosives which are managed so as to be flown into people or structures than such an attack may result in loss of life or material loss. The list of potential targets is virtually unlimited, but it needs to be pointed out that these could include important and strategic infrastructure (Finn, 2011).

Methodology

As part of the research, both primary and secondary data were collected. The primary data collection involved both qualitative and quantitative methods. Primary data was collected using an online survey issued to 66 port-related respondents and from five semi-structure telephone interviews, taken from a voluntary subset of the survey respondents.

The main research question proposed is:

RQ1 How can UAVs be effectively utilised to enhance port security?

In order to address the main research question, it was necessary to explore some additional themes, such as: what are the key security threats that a port faces; the extent to which a UAV can become a security threat; the efficacy of UAVs in complementing existing security measures; the extent to which UAVs can be seen as a health and safety risk; and whether UAVs should be registered with the appropriate aviation authority. It is these additional themes which were reflected in the content online survey.

Results and Discussion

A total of 66 respondents participated in the survey. The data were collected using online tools (SurveyMonkey.com) while taking into account relevant ethical considerations. The first question was concerned with the field of expertise of the respondent. Table 1 summarises the responses received:

Table 1: Respondents' field of expertise

Field of Expertise	Responses
Port security expert	14.1%
Port security equipment supplier	3.0%
UAV expert	12.1%
UAV equipment supplier	6.1%
Port official	16.2%
Customs official	6.1%
Other governmental organisation official	22.2%
Other non-governmental official	20.2%

As shown in Table 1 the majority of the respondents were governmental organisation officials. Only 12.12% of the respondents were UAV experts, while 6.06% were suppliers of UAV equipment. 14.14% of the respondents were port security experts, which increases the reliability of the data they provided. The next question referred to the respondents' familiarity with UAVs, with the results in Table 2.

Table 2: Familiarity with UAVs

Familiarity with Unmanned Aerial Vehicles (UAVs)	Responses
Very familiar	28.6%
Fairly familiar	44.4%
Slightly familiar	21.8%
Don't know	3.2%

As the results show, only 28.6% of respondents indicated that they were very familiar with the devices in question. 44.4% of respondents declared that they were fairly familiar with the device, while 21.8% said they were slightly familiar with UAVs. Only two respondents (3.1%) claimed they did not know anything about this type of aerial vehicle. The third question of the survey is "how serious do you consider the threat from UAVs to port security?" As shown in Table 3, 74.6% of the respondents considered that the threat UAVs pose to port security is either serious (38.1%) or very serious (36.5%).

Table 3: Seriousness of threat from UAVs

Severity of threat from UAVs to port security	Responses
Very serious	36.5%
Serious	38.1%
Mildly serious	20.6%
Not at all serious	1.6%
Don't know	3.2%

As observed in the literature (Talas, 2010), before 9/11, the most significant threats to port security were drug smuggling and organised crime. However, after those attacks, terrorism became a significant threat. Bernard (2015) argues that one of the most significant current threats to port

security comes from cyber-attacks, which could be conducted by terrorist groups using unmanned aerial vehicles. As identified by Dedrone (2016), UAVs may have certain weaknesses that could be exploited by terrorist organisations. Synergia (2016) argued that UAVs can be used for reconnaissance and surveillance, smuggling, or even electronic attacks. Also, it was identified in the literature that UAVs have a capacity to transport small loads of up to 1 kg across a pre-established route using a GPS signal (Dedrone, 2016). This could enable terrorists to transport explosive devices into secure areas of the port. Therefore, the primary data that indicate UAVs may pose a serious security threat are consistent with the findings of the literature.

The fourth question is “Please rank accordingly the risk of UAVs in terms of a security threat where 1=highest risk and 5=lowest risk.” The results are shown in table 4. The majority of the respondents indicated that the highest risk is that of an act of terrorism: 39.7% of the respondents indicated the highest risk. Furthermore, 20.6% of the respondents also indicated that there is a higher risk of illegal surveillance using UAVs. This is consistent with the findings of the Synergia (2016) report, which claimed that UAVs can be used to identify potential targets or conduct surveillance missions that would help the user access information that would have otherwise been unavailable to them. The report also indicates that the increased popularity of these devices with the general population, which has led to an increase in demand and purchase of UAVs, makes it difficult to know whether the purpose of such purchases is recreational use or if the buyer has criminal intent. It is interesting to observe from Table 4 that the respondents considered that there is a limited risk to using a UAV to smuggle weapons into the secure areas of the port, considering the fact that Dedrone (2016) claims the UAVs would be able to transport a small explosive device (approximately 1 kg) into secure locations.

Table 4: Security risks from UAVs

	1=highest risk				5= lowest risk
Security Threat	1	2	3	4	5
Smuggling arms and ammunition	7.9%	20.6%	27.0%	14.3%	28.6%
Illegal surveillance	20.6%	11.1%	25.4%	30.2%	11.1%
Smuggling of contraband	15.9%	27.0%	11.1%	27.0%	17.5%
Act of terrorism	39.7%	19.1%	22.2%	9.5%	7.9%
Other unauthorised act	14.3%	20.6%	12.7%	17.5%	33.3%

The fifth question is “In your opinion how effective could the deployment of UAVs in a port facility complement existing security measures?” The deployment refers directly to the monitoring requirements as prescribed in the ISPS Code, namely the monitoring of the ship-port interface; port areas; and ships stores (Table 5)

Table 5: Effectiveness of UAVs to complement existing security measures

ISPS monitoring requirement	Very effective	Effective	Less effective	Hardly effective	Not at all effective	Don't know
Monitoring the ship-port interface	57.1%	27.0%	12.7%	0.0%	1.6%	1.6%
Monitoring port areas	66.7%	25.4%	4.8%	0.0%	1.6%	1.6%
Monitoring ships stores	23.8%	27.0%	28.6%	9.5%	4.8%	6.4%

Despite the security risks that the respondents identified in relation to the use of UAVs, Table 5 demonstrates a confidence that UAVs can be used to increase port security. Sixty-six per cent of the respondents believe that UAVs can be effective in monitoring port areas that do not benefit from surveillance. Furthermore, 57.14% of the respondents also considered that UAVs could be very effective in monitoring ship-to-port interfaces. Synergia (2016) found that the UAVs available for civilians have different functions that enabled the users to control the specific capabilities of the device, such as speed, flight time, or reaction to different weather conditions. Also, different models of UAVs allow for various altitudes or distances of flight, making them rather flexible in covering large areas as far as surveillance is concerned.

The sixth question is “In your opinion should it be mandatory for UAV ownership to be registered with local or state authority?” (Table 6).

Table 6: Mandatory registration of UAVs with a local or state authority

Answer choices	Responses
Strongly agree	73.0%
Agree	17.46%
Neutral	7.94%
Disagree	0
Strongly disagree	1.59%

As we can see from Table 6, the majority of the respondents (73.02%) strongly agree with the registration of ownership with the local or state authorities. As the Synergia (2016) report showed, the number of civilian users of UAV devices is increasing, and the authorities have no possibility of determining the purpose for which the UAVs are being purchased. This increases the risks associated with the use of UAVs by civilian users; however, the authorities could not breach the right to privacy of a person, only their right to use a device that can potentially be employed with criminal intent. Nevertheless, the registration of such a device would associate the owner with a specific device identified by a unique serial number. This can both increase the safety of the device user and make it easier for the authorities to identify the owner of a device who intended to use it to commit a criminal act. Only one respondent expressed a strong disagreement with the registration of UAV ownership.

Conclusion

The study has revealed some interesting findings regarding the application of UAVs in port security with a view to enhancing security and complimenting existing security regimes. It is also noted that the presence of UAVs can themselves be perceived to be a threat to port operations, hence the high proportion of respondents looking for UAVs to be registered with a local or state authority. There is scope for the study to be extended to include a wider geographic area and also to address other nodes in the supply chain beyond merely ports.

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