

38 efficiently. Software companies such as Autodesk are working to develop software that
39 allows users to effectively and efficiently gather and manipulate data collected by
40 UAVs. Autodesk, which already offers software that is widely used for building
41 information modelling, has within recent years been expanding its usefulness to the
42 construction industry by purchasing Skycatch, a company that makes hardware and
43 software for the construction industry, and investing in 3D Robotics to develop cloud-
44 based data collection from specialized UAV equipment [1].

45 **2 Literature Review and Methodology**

46 Unmanned aerial vehicle regulations were in a period of temporary uncertainty from
47 the passage of the Federal Aviation Administration’s Modernization and Reform Act
48 of 2012 (the Act) until enactment of the current UAV regulations in August, 2016. The
49 Act required the FAA to develop regulations that would allow UAVs to be safely
50 implemented into domestic airspace by September 30, 2015 [4]. When the Act was
51 passed, commercial UAV use required prior FAA approval, which was typically
52 obtained by applying for a Section 333 Grant of Exemption or Certificate of Waiver or
53 Authorization [5]. In the interim period between the passage of the Act in 2012 and the
54 adoption of the Small UAS Rule in 2016, there was a period of uncertainty about the
55 viability of future UAV use, while operators waited to determine if the new regulations
56 would foster their potential UAV use or be so restrictive as to make UAV use unviable.

57 A 2017 survey of 113 construction companies found that 61% of respondents
58 surveyed reported having used UAVs on their construction sites. UAV uses identified
59 by respondents generally fell into the categories of (1) photography/videography, (2)
60 surveying, (3) inspections, and (4) safety/security monitoring – with
61 photography/videography being the most prevalent use [6]. Additionally, a review of
62 Section 333 Exemptions granted as of October 31, 2015 revealed a total of 2,137
63 exemptions granted however, only 190 of those, or approximately 8%, were related to
64 the construction industry [7]. When granted, FAA Section 333 Exemptions were
65 generally valid for a period of two years. Section 333 Exemptions granted prior to
66 passage of the Small UAS Rule were still valid for a two-year period however, once
67 those exemptions expire UAV operators will need to request Part 107 Waivers,
68 discussed below.

69 Conventional legal research methodologies were used to compile information on the
70 current regulations applicable to UAV use. A comprehensive review of the Certificates
71 of Waiver or Authorization on the FAA’s website was used to compile information
72 about waivers from the current FAA regulations issued since the passage of the Small
73 UAS Rule.

74 **3 Results**

75 **3.1 Part 107 – Small Unmanned Aircraft Systems**

76 Enacted in August, 2016, the current regulations pertaining to the use of UAVs are
77 contained in Title 14 of the Code of Federal Regulations, Part 107. Known as the Small
78 UAS Rule, or Part 107, the regulations are applicable to small UAVs, defined to be
79 those weighing less than 55 pounds at takeoff, inclusive of any onboard attachments
80 [8]. Part 107, Subpart B contains the following requirements for UAV operation: the
81 operator must be at least 16 years of age, pass an Aeronautical Knowledge Test, have
82 a Remote Pilot Certificate, and the UAV must be registered with the FAA. Operation
83 must occur during daylight hours within the visual line of sight of the operator,
84 groundspeed shall not exceed 100 miles per hour, and altitude shall not exceed 400 feet
85 above ground level. Additional restrictions include prohibiting the UAV from being (1)
86 flown over people (2) operated from a moving vehicle, and (3) operated near airports
87 and other prohibited or restricted areas [8].

88 While some construction companies may be tempted to characterize their UAV use
89 as non-commercial on the premise that the UAV use is conducted by a company
90 employee rather than for hire and the data is for internal use only, the FAA has been
91 explicit in its interpretation of what constitutes commercial UAV use. Once the use is
92 in furtherance of a person's business, the use is categorized as commercial, even if no
93 compensation is received. Just as a realtor taking aerial photographs of a property can
94 be considered commercial use, so too can taking aerial photographs of a jobsite.
95 Regardless of whether the photographs are only used internally, the aerial jobsite
96 photographs are presumably being used to further the business interests of the
97 construction company, and the UAV use is therefore considered to be commercial [9].

98 **3.2 Part 107 Waivers**

99 Part 107, Subpart D allows the FAA Administrator to grant waivers to some of the
100 regulations listed above, provided operation of the UAV can still be safely conducted.
101 Applicants can request a certificate of waiver for the following regulations: operation
102 from a moving vehicle, daylight operation, visual line of sight operation, visual
103 observer, operation of multiple UAVs, yielding the right of way, operation over people,
104 and operation in restricted airspace [10]. Although these waivers are granted on a case-
105 by-case basis, at this time the FAA has explicitly stated it will not grant waivers for
106 package delivery by aircraft for compensation or hire.

107 To request a waiver, applicants must complete the application process via the FAA
108 website and provide a description of the proposed use as well as an explanation of how
109 the UAV operation can be safely conducted with the waiver requested. The FAA has
110 issued guidelines specific to each type of waiver to assist applicants in establishing how
111 operations will be safely conducted. For example, if an applicant seeks a waiver to
112 allow UAV operation over people – such as using the UAV on a construction site to
113 take photographs or to monitor safety or productivity, the FAA guidelines require the
114 applicant to (1) provide data demonstrating the UAV will not cause serious injury if it
115 makes impact with a person for any reason, (2) provide data addressing blunt trauma
116 and laceration injuries, as well as any other type of injury inherent to the UAV, (3)

117 include any operating conditions or limitations to be followed to ensure safety, and (4)
 118 any special knowledge, qualifications or skills of the operator that ensure safety of the
 119 UAV operation over people [10]. Similarly, if an applicant seeks a waiver to operate
 120 the UAV from a moving vehicle – such as using the UAV for survey purposes or
 121 stockpile management for linear construction, the FAA guidelines require the applicant
 122 to (1) provide a means of ensuring the area of operation is properly evaluated for
 123 potential hazards, which are constantly changing, (2) ensure the visual line of sight is
 124 maintained from the position of the moving vehicle, (3) ensure all persons involved in
 125 the operation of the UAV are free from distractions, and (4) ensure that in the event of
 126 a loss of data link, procedures are in place to account for the movement and positioning
 127 of a remote pilot and ground control station [11].

128 Each waiver granted will specify the nature and extent of the waiver granted, as well
 129 as any additional conditions imposed on the UAV operation [12]. Processing time
 130 varies but can take approximately 90 days [13].

131 3.3 Part 107 Waivers Granted

132 In the first year since implementation of the Small UAS Rule, the FAA granted 1,298
 133 waivers for various Part 107 regulations. As of the date of this paper, there are 2,520
 134 active waivers for various Part 107 regulations. As shown in Table 1, below, the
 135 majority of those waivers were issued to allow operation of the UAV at night, while
 136 very few have been issued to allow UAV operation above people.
 137

Table 1. Part 107 waivers active as of dates indicated.

Section Number	Regulation Waived	Number of Active Waivers One Year After Implementation	Number of Active Waivers as of Publication	Validity Period of Waiver
107.25	Flying from a moving vehicle	4	4	4 Years
107.29	Flying at night	1105	2,390	4 Years
107.31	Flying beyond pilot's visual line-of-sight	7	33	4 Years
107.33B	Visual observer	2	22	4 Years
107.33C	Visual observer	3	1	4 Years
107.35	Flying multiple aircraft with only one pilot	19	43	4 Years
107.39	Flying over a person or people	5	26	4 Years
107.41	Flying near airports/in controlled airspace	130	41	2 Years
107.51B	Flying above 400'	8	8	2 Years
107.51C	Minimum flight visibility	8	11	4 Years
107.51D	Minimum distance from clouds	7	10	4 Years

139 Each waiver granted contains both standard and special provisions regarding the
140 approved use. Standard provisions are applicable to all granted waivers and generally
141 require the certificate of waiver to be presented upon request, require the holder of the
142 certificate to comply with the terms of the certificate, and explicitly state the certificate
143 is non-transferrable. Special provisions are then divided into common provisions and
144 special provisions specifically related to the regulation being waived. Common
145 provisions typically include but are not limited to statements authorizing the FAA to
146 cancel or delay or all operations due to safety concerns or violations of the certificate
147 and stipulate that UAV operations are to take place in Class G airspace unless a specific
148 waiver is sought to operate in other airspace classifications. Special provisions specific
149 to the regulation being waived are more specific. For example, some of the special
150 provisions typically included in a waiver to operate over people include but are not
151 limited to: (1) having designated launch and recovery areas where those not
152 participating in the UAV operation are not allowed, (2) individuals directly
153 participating in the operation of the UAV must be easy to visually identify, (3) while
154 operating the UAV over people, ground speed must not exceed five miles per hour, (4)
155 a UAV operated over people must not exceed an altitude of more than 21 feet, (5)
156 operations must take place over private or controlled-access property and with
157 appropriate permission, and (6) prior to conducting UAV operations over people, those
158 people must be provided with notice of the UAV operation [14].

159 If a construction company happens to have a project that is in close proximity to an
160 airport, and the jobsite is located within airspace designated for an airport, UAV use
161 may still be possible. For example, in May, 2017, Lane Construction was granted a
162 Certificate of Waiver for Section 107.41 of the Small UAS Rule, allowing it to
163 operate a UAV within a designated area in Class C airspace near the Bangor
164 International Airport (BGR) for the purpose of aerial photographs. In addition to FAA
165 jurisdiction, the waiver also gives the Bangor Air Traffic Control Tower (ATCT)
166 jurisdiction over the UAV use and imposes additional coordination requirements on
167 the UAV operator, such as requiring the operator to (1) provide the BGR ATCT 24-
168 hours advance notice of details of the planned operation, (2) contact BGR ATCT 15
169 minutes prior to the commencement of the operation to obtain real-time approval, and
170 (3) notify BGR ATCT as soon as the operation is complete [15].

171 **4 Discussion**

172 Although only a limited number of construction companies have sought Part 107
173 waivers in the first year since implementation of the current regulations, there are
174 several possible explanations for this. First, a search of the FAA waivers granted using
175 the search term “construction” reveals only five current waivers granted to construction
176 companies. However, that does not necessarily mean only five construction companies
177 sought waivers, it only shows that five companies include the word “construction” in
178 the company name on their application. For example, a search of the waivers granted
179 using the search term “survey” reveals seven surveying companies with active waivers,
180 at least some of which may be related to the construction industry.

181 Second, the Part 107 waivers granted during the first two years since passage of
182 the Small UAS Rule were only for companies seeking exemptions from the new
183 regulations. Companies that were previously using UAVs and had previously obtained
184 a Section 333 Exemption were able to continue operating their UAVs under their
185 existing Section 333 Exemption until it expired. Now that slightly more than two years
186 have passed since passage of the Small UAS Rule, all Section 333 Exemptions will
187 have expired and it is possible more companies will need to seek Part 107 waivers. For
188 example, in the first year after passage of the Small UAS Rule 1,298 were granted. As
189 of the date of this paper there are 2,520 active waivers, nearly twice the number that
190 were active during the first year after passage of the Small UAS Rule.

191 Third, because the approval process takes approximately 90 days, there could be
192 more waivers being considered that have not yet been granted.

193 If a waiver is sought, it is important to note and comply with the restrictions of the
194 waiver. For example, the default Part 107 regulations provide limitations of 100 miles
195 per hour and 400 feet for the maximum groundspeed and altitude, respectively.
196 However, as noted above, when a waiver is sought to fly over people, the default
197 regulations may be modified by the waiver – such as further restricting maximum
198 groundspeed and altitude to five miles per hour and 21 feet, respectively, to ensure the
199 safety of the people below the UAV. As shown in Table 1, above, most waivers granted
200 are valid for a period of four years, however waivers granted for Sections 107.41 –
201 flying near airports or in controlled airspace, and 107.51(B) – flying above 400 feet –
202 are valid typically valid for a period of two years.

203 **5 Conclusions**

204 Based on survey results from current UAV users, feedback is positive with regard to
205 the viability and return on investment for construction companies that implement UAVs
206 on their jobsites. Now that the period of uncertainty with regard to the FAA regulations
207 is resolved, it is anticipated that UAV use will increase, as evidenced by the nearly two-
208 fold increase in the number of active waivers. While the predominant use of UAVs in
209 the construction industry at the time is jobsite photographs, as operators become more
210 comfortable with UAV use, and as technology advances to make UAVs viable for
211 expanded uses such as monitoring worker safety, it is possible that UAV use in the
212 construction industry will increase.

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