Small Drone Development for Public Service Relating to Korean PPI

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***Abstract*—** Public Procurement for Innovation (PPI) facilitates making new market in the public sector with the government procuring power [1][2]. In order to make initial market for public service, the R&D program of MSIT is being advanced collaborated with the PPI process of PPS. In this paper, I introduced the small drone development program for PPI in Korea and explained the process and results of each stage.

Keywords—Drone; UAV; PPI; Public Service

I. INTRODUCTION

Nowadays, small drone demands for consumer and commercial market are rapidly increased. Specially, multi-copters for hobby and photographing are used familiarly to common people and considered to a toy and private camera. But the technology of drone for public service and commercial usage still must be developed for ensuring the safety, security and special mission. In Korea, considering the increasing commercial and public usage, small drone development project for public innovative procurement was launched on September, 2016, and will be advanced to 2019 for three years. Through the project, small drone companies are achievable to acquire initial market as well as technology advancement. Particularly, the R&D program of MSIT actively supports the technical development and the initial public market creation for small drone company according to the agreement between the Ministry Science and ICT (MSIT) and the Public Procurement Service (PPS). In the first year (2016), 6 projects were selected among 35 demands proposed from various government offices and support agencies. And in the last year, 3 projects were promoted among 29 demands.

In this paper, I introduced the Korean PPI process [3] relating to small drone development in Korea, and explained the status and results acquired for two years.

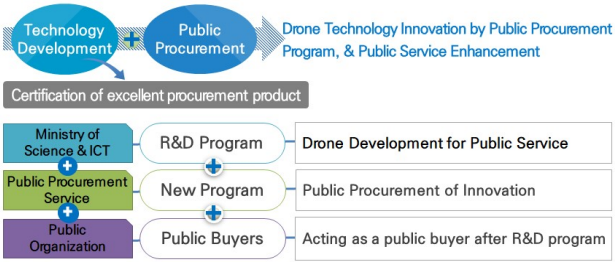

Fig. 1. Overview of Small Drone Development Program

II. DEVELOPMENT PROCESS

For drone R&D program relating to public innovative procurement, the first starting step is to gather the public demand and form a critical mass of purchasing power from the public organization side. In the first year (2016), 35 demands were submitted from various government offices and support agencies, and MSIT selected 6 projects considering technical innovation and possibility. In the second year, 3 projects were promoted among 29 demands. After selection, RFPs are generated from needs of each project including the required functionality, performance and price requirements. And also procurers express the intention to buy a mass of innovative products if the company can bring them to the public procurement market with the predefined price and quality requirements.

The second step is to select the final developing company with the presentation and field test evaluation. After the first competition is carried out through the document review and presentation evaluations, plural companies are selected for competitive dialogue and field test evaluation. And two or three months later with supported small budget, the second competition is performed through the field-test evaluation. In addition, during this period, the final RFP and adaptable technology level are determined through the competitive dialogue about technical challenge and price competitiveness. The field test evaluation is described in detail in the next chapter.

The third step is the stage of development based on the final RFP determined in the second step. In this stage, customers wish to validate their requirement and perform conformity assessment with the product of developer that can meet their needs, before actually procuring. Therefore, we conduct monthly progress review meeting with customer, developer together. We try to make continuous dialogue for the technical solution of additional requests or technical hurdles during development phase.

Not only the verification test to meet their requirements, but also the field operational test are performed to confirm the performance, safety and suitability of the customer's mission environment. Finally, when all assessments are completed, developing companies apply the certification of an excellent procurement products.

The final step is for certification of excellent procurement product. Excellent procurement is the process by which private contract is available to enable the rapid procurement of innovative products. Once registered, certifications are maintained for three years to reflect innovative characteristics. This process is a system already promoted by the Public Procurement Service. We plan to register the small drones developed in this project as excellent procurement products by this procedure and to help the public organizations purchase from time to time when the budget is secured.

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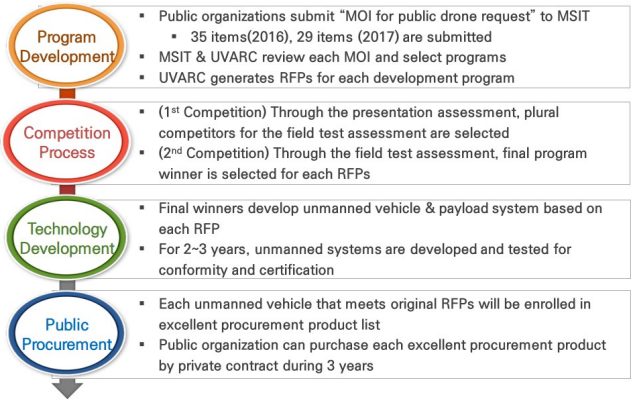


Fig. 2. Program Process of Small Drone Development connecting to PPI

III. Field-based Test Evaluation

In order to select final developers, we performed field-based test evaluations every times in the Goheung Aviation Center, Yeongwol and Busan. The main purpose of evaluation is confirm the flyable platform and the ability to perform the required mission. The evaluation items are fly in place, automatic takeoff and landing, cope with an emergency, mission flight, safety flight, operational convenience, etc.

Finally, 9 companies were selected for each mission. (6 companies in 2016, 3 companies in 2017) listed in Table I.

Fig. 3. Field-based Test Evaluation at Goheung Aviation Center in 2016

Fig. 4. Field-based Test Evaluation at Yeongwol and Busan in 2017

A. Searching a Missing Person

In order to search and rescue a missing person the quicker is the better. Therefore, AI drones are a good solution. For this purpose, high resolution EO/IR camera (max. payload 2kg) is installed and deep learning for real-time recognition is used to analyze and detect a missing person automatically.

Considering that it is operated under extreme conditions, several safety options are also adapted: parachute, collision avoidance, geo-fence, return-to-home, auto-landing, etc.

TABLE II. Drone for Searching a Missing Person

Customer	**Police Agency**
Equipment	EO/IR
GTW (kg)	16
Operating radius (km)	2
Operating time (min)	25
Size (mm)	1100 x 700

TABLE I. Small UAV Development Program for Public Procurement of Innovation

	Procuring Entity	Project Name	Contracted Company	Develop Period
2016	Korean National Police Agency	Development of a small UAV for searching missing persons	HUINS	19 month
	Korea Meteorological Administration	Development of complex sensor and imaging systems for small UAV on-board real time weather observations	3S TECH	19 months
	Ministry of National Defense	Development of the multipurpose UAV system for the military	NES&TEC	19 months
	Busan Regional Office of Ocean and Fisheries	Development of small UAV system which capable of offshore night long range operations for maintenance of navigational beacon	Edun-ENG	19 months
	National Institute of Fisheries Science	Development of hybrid UAV system for the surveillance of offshore red water contamination and measuring the marine environment	SUNGWOO Eng.	29 months
	Korea Land and Geospatial InformatiX Corporation	Development of sea mapping system using UAV to build coastal safety map	SAMCO	29 months
2017	Gangwon Provincial Office	Government Development of high-speed maneuver racing drone and video transmission technology for broadcasting relay	UMACair	20 months
	Busan Institute of Health and Environment	Development of small UAV system for detecting harmful air pollutants in emission gas from industrial complex	USIS	20 months
	Busan Port Authority	Oceanographic survey and investigation using unmanned surface vehicle(USV) with remotely operated vehicle(ROV)	MarineResearch	20 months

B. Real-time Weather Observation

Usually, in order to obtain the atmospheric data for weather observation, small balloon (radio-sonde) is employed. But not only the cost of disposable balloon, but the station keeping problem is a big burden for observation. Small drones installed on-board weather sensors are proposed to observe data: wind speed, wind direction, temperature, humidity and atmospheric pressure, etc.

TABLE III. DRONE FOR WEATHER DATA GATHERING

Customer	Meteorological Admin.
Equipment	Weather sensors, EO/IR
GTW (kg)	12
Operating radius (km)	2.5
Operating time (min)	30
Size (mm)	1100 x 1000

C. Multipurpose UAV System for the Military

For military usage, several special missions are needed: detection, scout, protection, agility, etc. In this program, not only multipurpose small drone, but data encryption and tethered device for long operation are developed.

TABLE IV. MULTIPURPOSE SMALL UAV

Customer	Min. of National Defense
Equipment	EO/IR
GTW (kg)	11
Operating radius (km)	3
Operating time (min)	30
Size (mm)	1000 x 500

D. Maintenance of Marine Navigational Beacon

In the coastal region, there are visual aids to support the marine navigation through the marking their location with lights at night: light house, light pole, beacon, light float, etc. Because visual aids to navigation should be sufficiently seen within the required range, marine officials must check and maintain their lights every night.

Small UAV with IR and night-vision camera can perform the maintenance instead of human very quickly. But it needs technical solution to 20 km flight over the coast in the night, and furthermore it must be able to detect and check the lights automatically.

TABLE V. UAV FOR MAINTENANCE OF NAVIGATIONAL BEACON

Customer	Busan Regional Office of Ocean and Fisheries
Equipment	EO/IR, Night-vision
GTW (kg)	12
Operating radius (km)	10
Operating time (min)	40
Size (mm)	1000 x 700

E. Surveillance of red tide and marine contamination

Korea is surrounded by sea on three sides. Therefore, the surveillance of red tide and marine contamination is an important role of the office of ocean and fisheries. For this purpose, hybrid UAV system that can do vertical takeoff and landing, hovering and fixed-wing flight is developed equipped with multi-spectral sensor, and the required flight time is over one hour and the operating radius is over 15 km.

TABLE VI. SMALL UAV FOR SURVEILLANCE OF MARINE ENVIRONMENT

Customer	National Institute of Fisheries Science
Equipment	EO/IR, Multi-spectral
GTW (kg)	19
Operating radius (km)	15
Operating time (min)	60
Size (mm)	2700 x 1530

F. Coastal Mapping System using UAV

The coastal terrain changes sharply due to tide and ebb tide. For the safety, the government should build coastal safety map periodically and inform the changes of these terrain. For this purpose, the coastal mapping system using UAV is requested and hybrid aircraft is being developed collaborated with 3D mapping technology.

TABLE VII. SMALL UAV FOR COASTAL MAPPING

Customer	Land and Geospatial InformatiX Corporation.
Equipment	EO
GTW (kg)	4.2
Operating radius (km)	3
Operating time (min)	60
Size (mm)	2200 x 1400

G. High-speed Racing Drone and Video Transmission

As the interest of small drones increases, many drone racing competitions are being held. But with the little drones, it is hard for people to chase them with their eyes, and there are some difficulties with shooting with broadcasting cameras. For this purpose, a large scale racing drone (1,000+mm) capable of flying at a speed of more than 160 km/h is being developed. It is being developed as a system capable of transmitting Full HD broadcast video with a delay of less than 1 second.

For the safety during the racing, geo-fence, return-to-home, auto-landing technology will be adapted in this racing drone.

TABLE VIII. HIGH-SPEED RACING DRONE

Customer	Gangwon Provincial Office
Equipment	EO
GTW (kg)	7.5
Operating radius (km)	2
Operating time (min)	10
Size (mm)	1150 x 850

H. Detecting harmful air pollutants in emission gas

Many harmful pollutants are emitted from the chimneys in the industrial complex. Although the government oversees and controls them, it is difficult to collect and enforce pollutants quickly if people are directly involved in crackdowns. For this purpose, a small UAV equipped with a hyper-spectral camera needs to be operated for real-time air pollution scanning, and a system capable of collecting samples simultaneously when pollutant discharge is confirmed is being developed.

TABLE IX. SMALL UAV FOR AIR POLLUTANTS DETECTION

Customer	Busan Institute of Health and Environment
Equipment	EO, Spectral camera
GTW (kg)	10
Operating radius (km)	2
Operating time (min)	30
Size (mm)	1200 x 1000

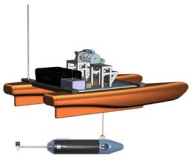
I. Water-area Management and Oceanographic Survey

Although maritime surveys using ships have been carried out, there is a disadvantage that the operation cost is expensive due to the use of vessels equipped with high-priced equipment. Furthermore, in coastal areas, there are many reefs and obstacles, which makes it difficult to survey, it needs innovative solution for low cost unmanned operation.

Last project of our program is the UMV system development for the oceanographic survey and investigation using unmanned surface vehicle (USV) operated with remotely operated vehicle (ROV).

TABLE X. UMV SYSTEM FOR COASTAL WATER-AREA MANAGEMENT

Customer	Busan Port Authority
Equipment	EO, Sonar
Payload (kg)	10
Operating radius (km)	2
Operating time (hr)	8
Size (mm)	1100 x 700



IV. CONCLUDING REMARKS

Four products in the year and five products in the next year will be procured through PPI process after certification of excellent procurement product. Currently, developments are underway to improve flight performance and to maintain mission capability, and some projects are undergoing field operational testing.

Through this collaboration program between R&D and PPI, it is expected to be a good opportunity to improve the technology of SMEs and to provide the initial market in Korea.

ACKNOWLEDGMENT

This research was supported by Unmanned Vehicles Advanced Core Technology Research and Development Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Science and ICT, the Republic of Korea.

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