Winter 12-6-2015

The Rise Of The Machines: Robotis, A Frontier In Educational And Industrial Robots In Korea

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ABSTRACT

Robot industry is quickly becoming one of the fastest growing markets in the world. Already used in various fields, robots are replacing more and more labors. The prospects for this industry is quite bright since many countries in the world are adopting programs and policies to develop the robot markets. In this paper, we will look into a Korean venture firm that is growing together with the robot industry: ROBOTIS. Beginning with the growth story of ROBOTIS, we will analyze the business environment the firm is facing. We will also look into the main products of ROBOTIS and how they correspond with the trend of the robot industry.

Keywords: Robotis, Industrial robots, Educational robots

INTRODUCTION

"Robots are beginning to augment and replace labor in a wide range of industries: a megatrend that is transforming the economics of manufacturing and reshaping the business landscape. Already used to fight wars, remove dangerous land mines, and fill customer orders…robots can perform quite a few of the jobs that humans currently do – often more efficiently and at a far lower cost" [9].

Sander et al. (2014) from the Boston Consulting Group prospected that robots are beginning to replace labor in a wide range of industries and this megatrend is transforming the economics of manufacturing and reshaping the business landscape. As a frontier in industrial and education robots in Korea, ROBOTIS (www.robotis.com) develops and produces robotic joints, controllers, sensors and other devices that are needed to control a robot. With the devices that it has developed, ROBOTIS has taken the lead in not only the industry of robotic actuators but also other field of contents stem from them, for instance, a set of educational humanoid. The very first step of the business has been taken as the founder's philosophical concern "Robot is…" in action. The founding C.E.O. ByungSoo Kim himself was indeed a talented robotics mania ever since he has started his life in college. Majoring in Electrical Engineering, Kim has participated and won first prices in a number of competitions in robotics including International Event - Mobile Robot Contest in 1995, Japan Micro-mouse Competition in 1997, and many international robot soccer competitions.

The field of Robotics in South Korea has always been hopeless; it was lack of both demands and interests. Things weren't so different in the early years of ROBOTIS. Despite the cutting edge skills and knowledge, it has hardly found the strategic plan of finding and meeting sufficient demands. What was different with ROBOITS, however, was it has spotted its initial chance in rare field of applied robotics: the robotic toys. ROBOTIS has exported thousands of it products "DIDI & TITI" in the United States and Japan, and this instant success has provided it with another chance of taking a step of developing DYNAMIXEL, now known as the most famous actuator made by ROBOTIS.

The development of DYNAMIXEL has dragged the company into the professional field of robotics from the field of toys, while it continues to develop "educational robotic kits" on the top of its experience of producing toys. ROBOTIS has pioneered its unique position as a single company that develops and produces professional robotic actuators as well as educational products for children, and this synergic position let it launch higher level robots that children can intuitively deal with: Bioloid. Bioloid has proudly walked into newly created field of educational robotics for children, making a unexpectedly great profit for the company, along side with the great success of DYNAMIXEL in professional field of Robotics. Kim has been designated as "Top 100 people brightens the Society in 2006," and the candidate for tens of awards. Today, it is keeping the lead with its humanoid platform for research "DARwin-OP" in professional field and educational humanoid "ROBOITS MINI" in educational robotics field.

In early days of ROBOTIS, it has focused in developing hardwares as a product, but it is now targeting to handle related contents such as softwares and even robot-related services. ROBOITS now introduces itself as a "Robotic Solution Company." In this case study, with a frontier in robotics, ROBOTIS, we propose the current status and future prospects of robot industry in Korea.

GROWTH OF ROBOTIS

In his younger years, C.E.O. Kim has always preferred visiting a local market electronic components and creating things out of it than studying with books in college. Without the easily accessed web resources, the only way he could possibly learn and experience that are not available in college was either reading related articles or asking other who are capable of inform about them. Despite the difficulties, he passionately tried that he even spent most of the money he has made from tutoring high school students. Even after college, he has discarded an occupation in a decent corporation to kick off his dream of robotics.

After a few years of business, a college alumnus suggested to take the same boat. He is the current C.T.O. of ROBOTIS, HA In Yong. Their business has been funded by the start-up supporting program in Korea University, gave them the chance to proudly start business.

Since then, ROBOTIS has developed "DIDI and TITI," a set of robotic toys (see Figure 1) that resemble mice that utilizes network to perform. It brought the company a great success as thousands of them were exported, suggested to take another step. The following step, however, was a step on a fall; their attempt to expend their occupation to production and marketing alongside with development returned them a great failure as the tremendous amount of components it has imported from China found to be useless. The company hardly maintained space for storing products and filed financial debt up to 2 billion Korean Won (approximately 18 million US Dollar). For years of harsh time, Kim has to spend most of his time to loan for worker's salary, but in the end of hopeless times, he has perfectly cleared all the financial debt with the development DYNAMIXEL. Kim has mentioned that the field of Humanoid is known to be a frozen business with most difficult in technology, and he was sure that it is why ROBOTIS can possibly take the lead in the field. In an interview with etnews, Kim said, "DYNAMIXEL is being used in professional field in over 40 countries, and we are dreaming for another challenge with the possibility we have found in it."

Figure 1. DIDI & TITI

PROSPECT OF ROBOT INDUSTRY

As shown in Figure 2, worldwide spending on robotics is expected to reach $67 billion by 2025 from just over $15 billion in 2010. The leading IT companies like Google and SoftBank are keep expanding their business to robot industry.

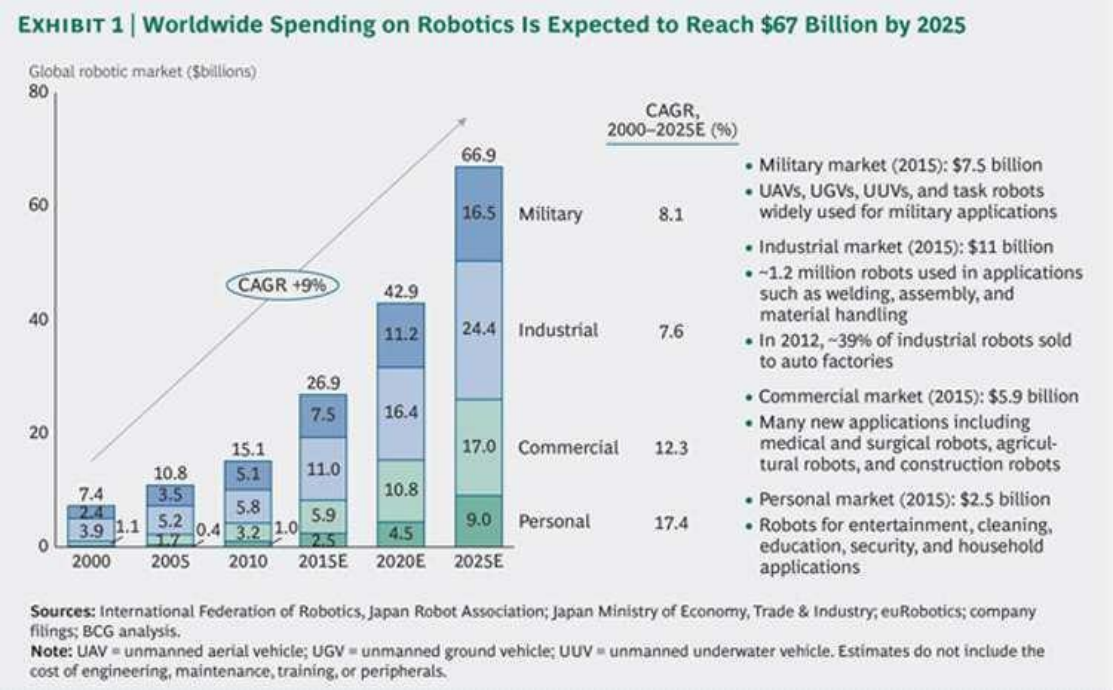

Figure 2. Worldwide Spending on Robotics

Note: UAV = unmanned aerial vehicle; UGV = unmanned ground vehicle; UUV = underwater vehicle. Estimates do not include the cost of engineering maintenance, training, or peripherals.
Source: [9]

Many countries of the world implemented various policies promoting robot technology to follow the megatrend. Barack Obama, the current president of the United States, launched the Advanced Manufacturing Partnership (AMP) that included investing in next-generation robotics in 2011. Japanese Prime Minister Shinzo Abe also addressed the OECD assembly in Paris in 2014 that Japan will spark a new industrial revolution based on robots. In addition, Xi Jinping, the president of China that rises as the world's No.1 manufacturing robot market, highlighted that China will become the greatest robot power in the world. EU launched the SPARC, the partnership for robotics in Europe as well.

According to the International Federation of Robotics (IFR)'s "World Robotics 2014", the world market of robot reached $14.8 billion in 2013 on the support of the US manufacturing's returning to growth and the economic recovery of Europe as Table 1 [12].

Table 1. Trend of the World's Robot Market Size

(Unit: million USD)

Type		09'	10'	11'	12'	13'	13'/12'	Annual Avg
Manufacture		3,976	5,678	8278	8496	9507	11.9%	24.3%
Service		3,801	3,890	4206	4860	5282	8.7%	17%
	Profession	2,200	3,353	3569	3569	3567	-1.9%	13%
	Individual	601	537	636	1224	1714	40.0%	30%
Total		6,777	9,568	12483	13356	14789	10.7%	21.5%

Source: [12]

Among the growth, the market size for service robot increased by 8.7% in 2013 compared with the previous year, from US$ 4.86 billion to US$ 5.28 billion. The service robot market has been built around medical robots for therapy, field robots for milking and stockbreeding, defense robots for unmanned aerial vehicle (UAV), mine detection, and clearance, and home robots for domestic tasks, but the growth of entertainment robot, home robot, and distribution robot stood out in 2013. The market size of entertainment robots increased by 73.9% compared to the size of 2012 (see Table 2).

Table 2. Trend of Service Robot Market Size

(Unit: million USD, y-o-y, %)

Types	2011		2012			2013		
	Amount	Proportion	Amount	Proportion	Increase	Amount	Proportion	Increase
Field Robotics	879	22%	847	17%	-3.6	883	17%	4.3
Logistic Systems	166	4%	196	4%	18.0	216	4%	10.2
Medical Robotics	1,356	33%	1,499	31%	10.5	1,499	28%	-3.3
Defense Applications	748	18%	818	17%	9.4	792	15%	-3.2
Domestic Tasks	454	11%	697	14%	53.5	799	15%	14.6
Entertainment Robots	**166**	**4%**	**524**	**11%**	**215.6**	**911**	**17%**	**73.9**
Others	436	8%	279	6%	-36.0	231	4%	-17.2
Total	4,205	100%	4,860	100%	15.6	5,282	100%	8.7

Source: [12]

The International Federation of Robotics (2014) forecasted that the size of US$ 30 billion market for service robot is expected to be formed from 2014 to 2017. As a big increasing trend of market for service robot is anticipated in the medium to longer term due to many countries' service robot market creation and expansion, the markets for entertainment robots and defense robots, which ROBOTIS focuses on, are forecast to grow enormously. As shown in Table 3, the market for defense robot is expected to increase by about 12 times, and the market for service robot also is expected to increase by around 5 times by 2017, compared to the markets size in 2013.

Table 3. Expected Size of Service Robot Market

Types	unit			$1,000		$ million
	'12	'13	'14~'17(e)	'12	'13	'14~'17(e)
▪ Service Robot(Total)	3,064,810	3,932,612	31,553,270	4,860,228	5,282,031	30,087
▫ Professional Service	20,214	21,036	134,520	3,635,525	3,567,408	18,909
Field	5,343	5,921	33,850	846,585	882,849	5,179
Professional Cleaning	324	323	2,550	6,608	7,380	113
Exploration & Maintenance	106	277	3,850	13,281	26,275	162
Construction&Demolishing	472	650	2,720	33,875	42,731	164
Logistics System	1,376	1,889	10,250	196,091	215,874	1,433
Medical	1,314	1,286	7,130	1,449,052	1,449,479	6,736
Rescue & Safety	78	105	1,140	24,254	22,342	268
Defense	10,327	9,520	54,050	818,324	791,982	4,000
▫ Personal Service	3,044,596	3,911,576	31,418,750	1,224,703	1,714,623	11,178
Domestic Use	1,961,339	2,700,235	23,891,750	697,213	799,491	6,546
Entertainment	1,083,098	1,210,633	7,512,550	523,559	911,211	4,455
Elderly&Handicaped Aids	159	708	12,400	3,931	3,921	110

Source: [12]

MAJOR PRODUCTS OF ROBOTIS

The robot industry has a huge possibility to grow, and the service robot market ROBOTIS focuses on has a high potential as well. ROBOTIS offers educational kit such as ROBOTIS PLAY for students, and the smart actuator 'DINAMIXEL' which can be applied to various applications as it includes functions of motor, decelerator, controller, and communication. Table 4 shows the main products of ROBOTIS

Table 4. Products lines of ROBOTIS

Targeted Field	Image	Targeted Usage	Products
Educational Robotic Kits		Mania	ROBOTIS STEM ROBOTIS BIOLOID ROBOTIS GP
		Beginners	ROBOTIS IDEAS ROBOTIS PLAY ROBOTIS SMART
		Actuator	DYNAMIXEL DYNAMIXEL PRO
Modulated Product		Research	3-finger Hand
Platform		Individual and Research	DarwIn-OP
Etc			Robot Accessories and Mobile Solutions

Source: ROBOTIS website

Educational robotics kits

In 2000, there has been a rapid grow in research field of Robotics, specifically in US, Japan, and South Korea. The recent sparkling achievements in research in not only the Robotics but also other fields of Engineering has brought about a focused interest of the society as the future strategy of the nations, and this has spot-lighted a need of education of potential future Robotic Engineers, the Children. To meet the demand, ROBOTIS started to seek to develop very intuitive robotic kits so any children interested in any kinds of robots can play with them.

In 2009, ROBOTIS has launched a new line of products, and it has named it "OLLO." Meaning "All + Robot," its primary goal is not only letting children to play with them, but also to develop their creativity, scientifically thinking strategy, and interest in Robotics. With such catchy tools, ROBOTIS has been looking forward the children to acquire self-learning skills in Mathematics and Science from the experience scientific system in the educational robots.

The core of OLLO is the farthest "Intuitiveness," and "Degrees of Freedom." Children can easily build a robot in their need without heavy tools, while the range of resulting system is not restricted in any kind of manuals; with the sensors, motors, and plastic tools that are mechanically engineered that are provided and sold separately, they bring children's imagination to endless. Today, ROBOTIS officially changed the name of OLLO to ROBOTIS DREAM.

Other than OLLO, ROBOTIS has introduced higher-level educational robotic kits that utilizes more and higher level sensors and actuators. Recently launched ROBOTIS Smart is getting more and more interests from children and their parents with the involvement of smart phones.

Figure 3. ROBOTIS IDEAS

Figure 4. ROBOTIS SMART

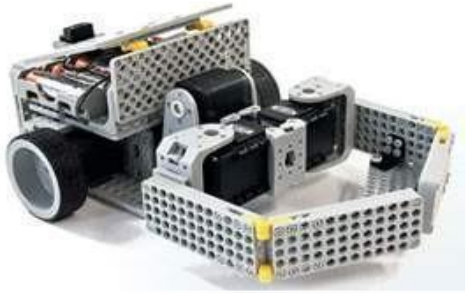

Figure 5. ROBOTIS STEM

Figure 6. ROBOTIS PREMIUM

Source: ROBOTIS Website

Actuators

C.E.O. Kim has mentioned that he has started the business with the disappointment with the lack of performances of the actuators in public markets back in the years he has participated in a number of competitions in Robotics. ROBOTIS has sought to solve such problems as it develops a better actuator for robot manipulation, end up introducing DYNAMIXEL at glance. DYNAMXEL, a modulated actuator, has essential electrical and mechanical systems, such as a motor driver and reduction gears, integrated alongside with a electrical motor. Many robotics researchers and hobbyists have found convenient to build a robotic systems with sufficient performance, and such response from the market firmly positioned the company in professional actuator industry.

In an effort to take a further step into a professional robotics actuator industry, ROBOTIS has introduced a new line of DYNAMIXEL called "DYNAMIXEL PRO." While these costs far more than conventional ones, DYNAMIXEL PROs exhibits better performances by far; with much higher resolutions of rotation with higher powered motors and reduction gears with much higher reduction ratio, ROBOTIS is targeting to meet further demands of professional researchers in larger scale institutions and laboratories. While there have already been existing high-powered actuators in the industry, what makes DYNAMIXEL PRO different from others is that it has the modular structure of conventional DYNAMIXEL integrated that makes a build a lot more simpler. Such convenience is always welcomed by researchers and developers because conventional systems are complicatedly structured with actuators which make not only the design and build but also part replacement very hard.

ROBOTIS is taking its effort to prove the coincidence of the convenience and performance of its product as it develops a full-sized humanoid using DYNAMIXELs only, mostly DYNAMXIEL Pros. The humanoid, called "THOR-MANG" is performing in DARPA Robotics Challenge.

FUTURE OF ROBOTIS

ROBOTIS is taking a challenge in DARPA Robotics Challenge. Hosted by DARPA, Defense Advanced Research Projects Agency in the US, DRC is a huge scaled robotic competition aiming for the development robots that can substitute humans when needed. Citing DRC website, "The DRC is a competition of robot systems and software teams vying to develop robots capable of assisting humans in responding to natural and man-made disasters." Participating robots are given eight missions that are likely happen in real disaster site like Fukushima Nuclear Plant explosion, and these includes driving a car, closing valves, drilling a wall, and opening human-oriented doors. In last trial, the full-sized humanoid THOR-MANG by ROBOTIS has ranked the 9th among all participants. In the upcoming final DRC, a new team from South Korea, team SNU from Seoul

National University, is also participating with a revised version of THOR-MANG.

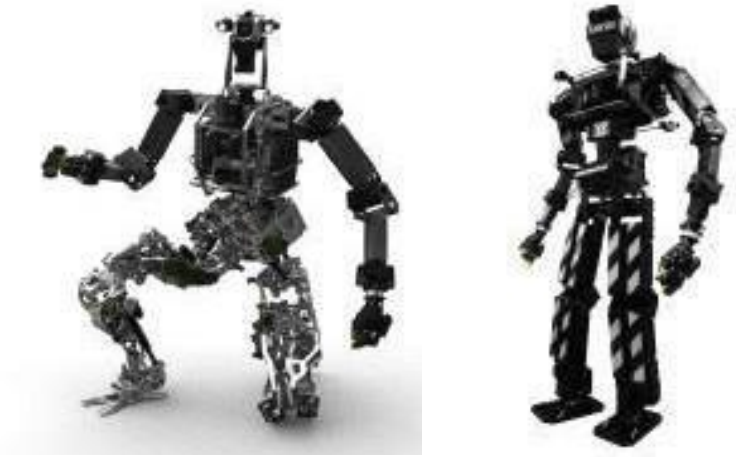

Figure 7. THOR-OP (left) and THOR-MANG (right)

Source: DARPA ROBOTICS CHALLENGE website

CONCLUSION

Many countries all over the world including Japan, the U.S., China and Korea, are already investing in the robot industry. Considering the increasing demands, the future of robot industry is very promising, and ROBOTIS seems to fit the current trends of robot industry. ROBOTIS' educational kit has been selected as teaching kits for the duty training of robot teachers. Their DINAMIXEL has been exported to more than 40 countries since the release, and 39 teams out of 40 installed the ROBOTIS' DINAMIXEL during RoboCup (Robot World Cup) in 2014. And now, two robots with the DINAMIXEL are participating in DARPA challenge.

ROBOTIS seemingly never stays in their current success, yet always takes another chance with great enthusiasm. This is why a greater and brighter future is expected with ROBOTIS.

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