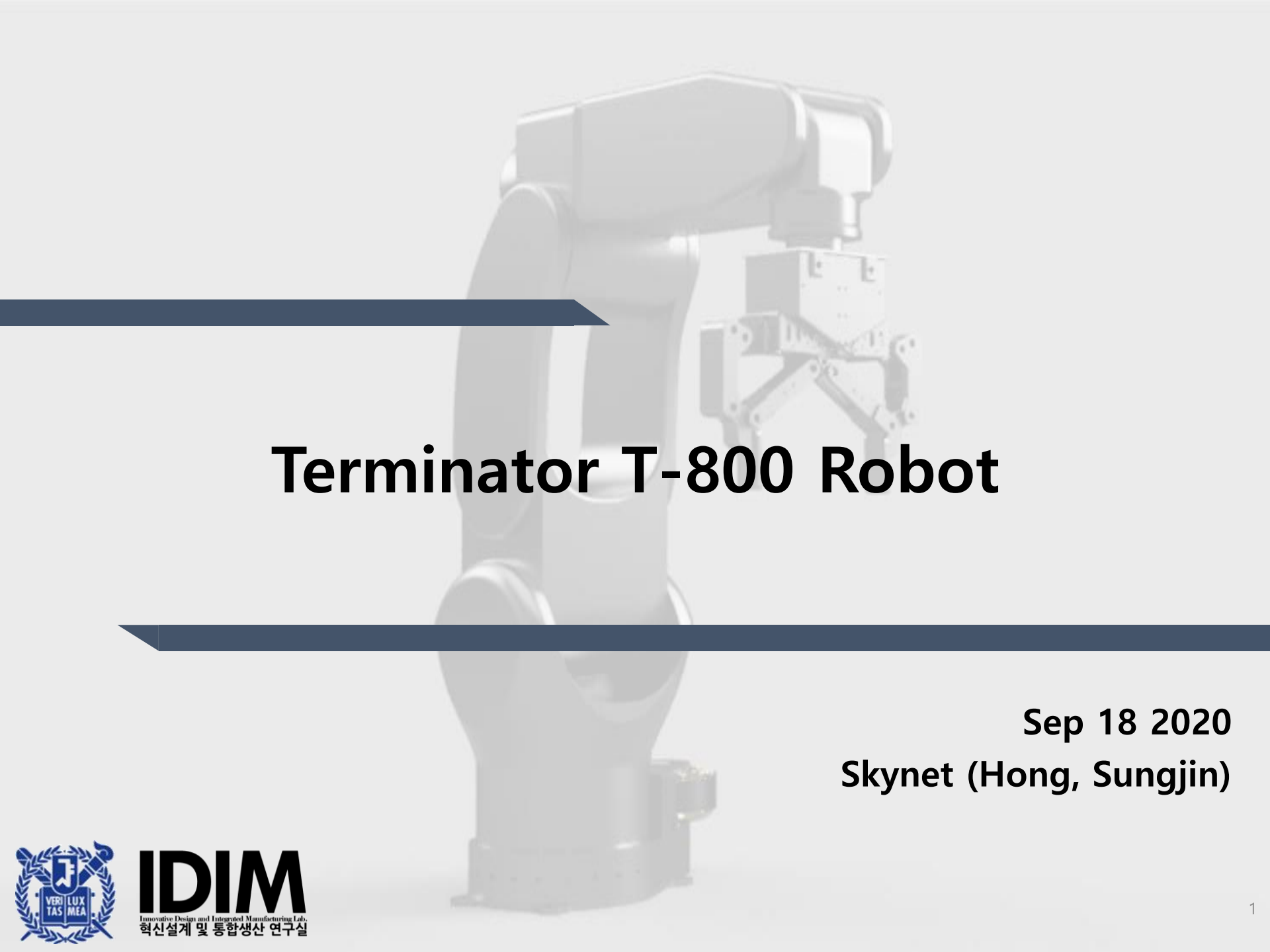

Terminator T-800 Robot

Sep 18 2020

Skynet (Hong, Sungjin)

IDIM
Innovative Design and Integrated Manufacturing Lab.
혁신설계 및 통합생산 연구실

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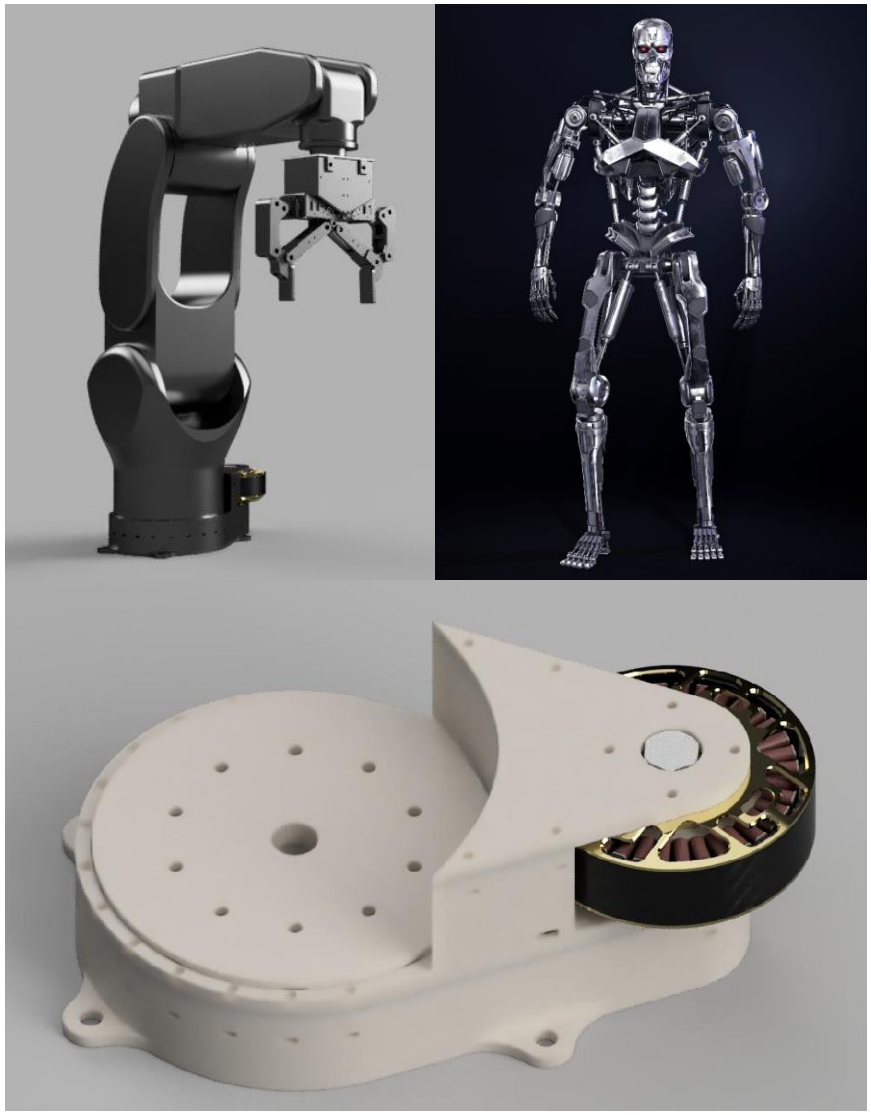
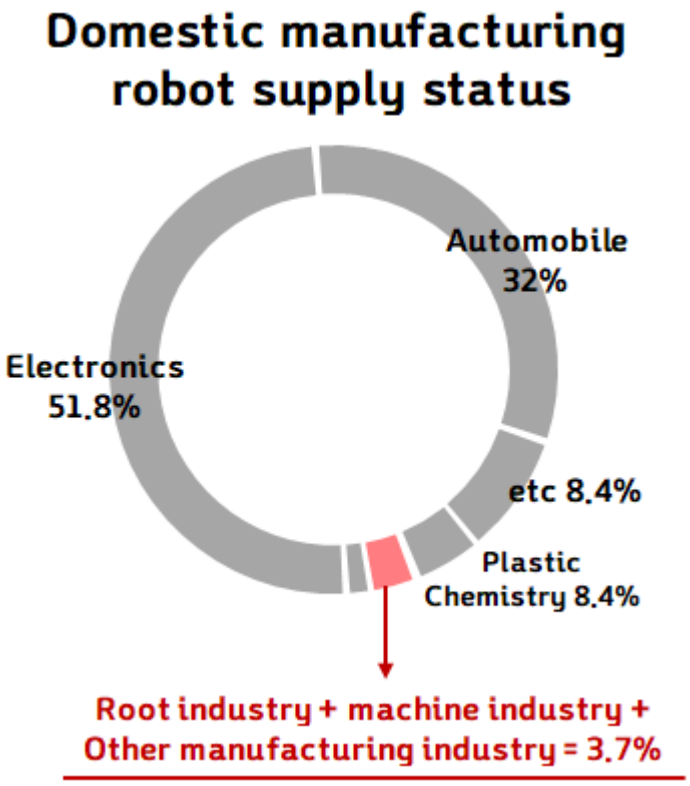


1 Problem statement – motivation



Before application of smart factory

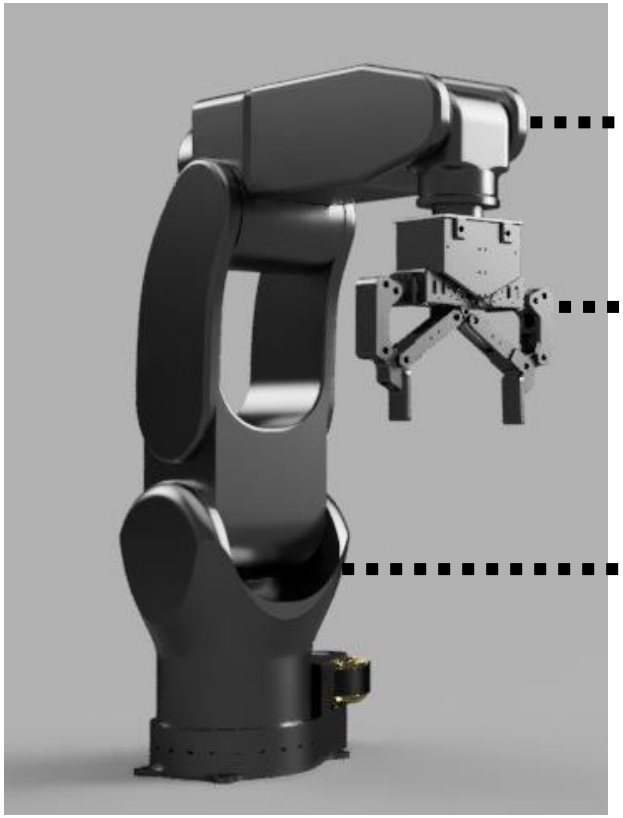
Smart factory application

Transferring to smart factory is difficult

* source: IFR 2018, WR Industrial Robots ('17)

1 Problem statement – purpose

➢ SMEs having difficulty in implementing Smart Factory



Over-specification Hardware, High cost robot

- Mostly simple repetitive tasks are done in SMEs
- Current robots are over-specified for use in simple tasks

Difficulty in force control due to high reduction ratio

- The reducer is easily damaged even with a weak impact.
- Cannot be used for processes such as complex assembly required

High performance controller → Cost increase

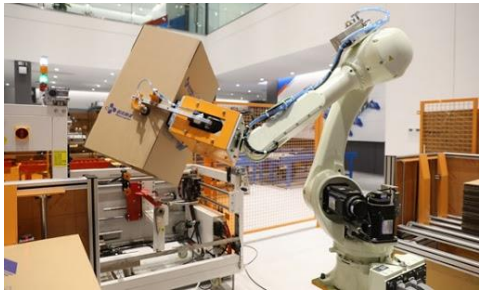
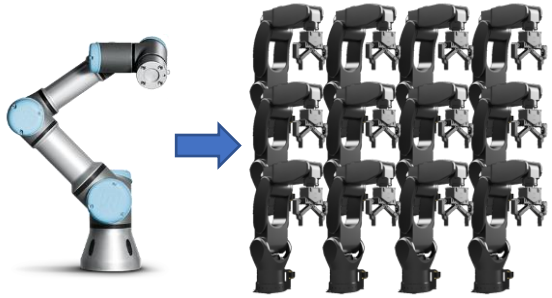
- High-performance controller for many calculations, increasing the price and volume
- Ultra-low-latency real-time control with 5G technology ->Necessity of brainless robot

Need of appropriate robot for SMEs

2 Solution - Appropriate robot concept

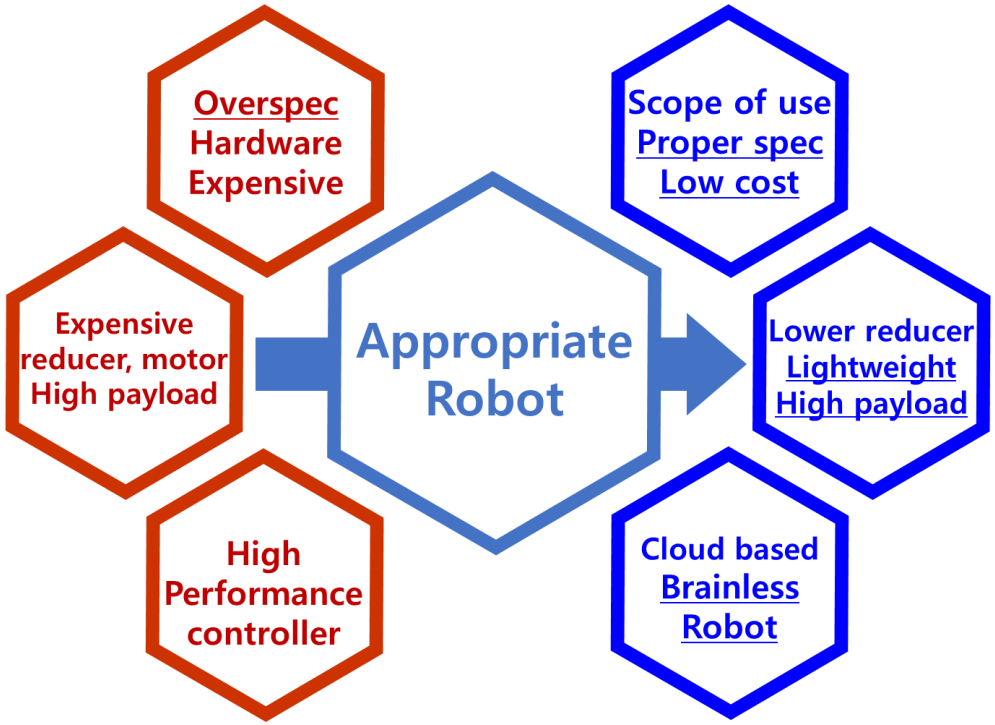
➢ Appropriate robot considering the facility of SMEs

- Automation of simple tasks
- Introducing multiple robots at the same cost
- Applying robots to the entire site without significantly changing the facility/environment

Simple task automation	Introduction of multiple robots	Robot application throughout the site
		
• Simple task automation with appropriate robots • Automation without large facility investment such as building a line for automation	• Robot with significantly lower price compared to companies • Multiple robots can be supplied at the same cost	• Automate multiple tasks with multiple robots, not one process automation with one robot • Applying the robot to the entire site

2 Solution - Appropriate robot concept

- Affordable price/spec robots for small and medium-sized businesses
  - Low-cost robot with appropriate specifications considering the range of robot applications
  - Replace expensive core parts (harmonic drive, controller, etc.)
  - Cloud-based brainless robot for simultaneous control of multiple robots

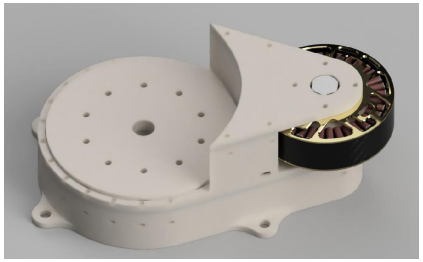


2 Solution - T-800 key features

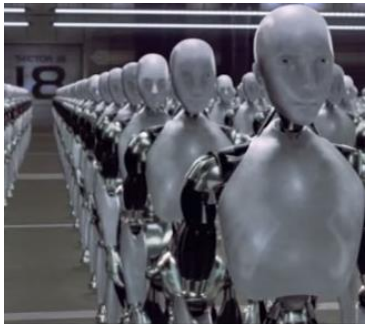
➢ Manufacturing cost reduction strategy

1. Eliminate **<u>expensive over-spec hardware</u>** from commercial robots
   - Replace expensive exterior parts with lightweight plastic
   - The rigidity of the robot is secured by an aluminum frame inside.

2. Replace expensive reducer (harmonic drive) with **<u>plastic belt drive</u>**
   - Lightweight & increased durability against collision
   - Reduce reduction ratio and compromise repeatability
   - <u>Position precision control (compensation) through real-time computer vision</u>
   - Precise force/torque control with low reduction ratio



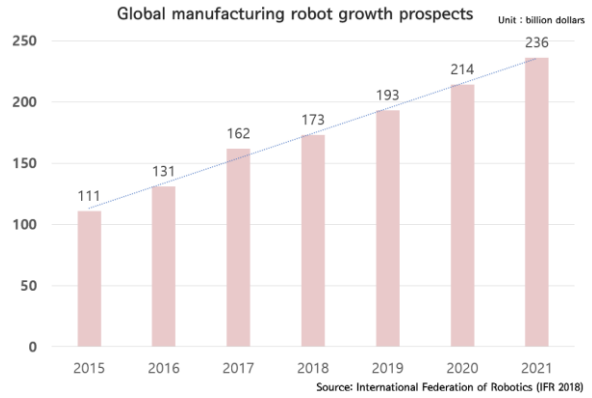
3. **<u>Cloud-based brainless robot</u>** for simultaneous control of multiple robots
   - Minimize the controller built into the robot
   - Complex computation and integrated control through cloud computing
   - Supplying multiple robots simultaneously at an affordable price



3 Marketing strategy - market analysis

➢ Robot market outlook

- The global manufacturing robot market is expected to grow at an annual average of 10%



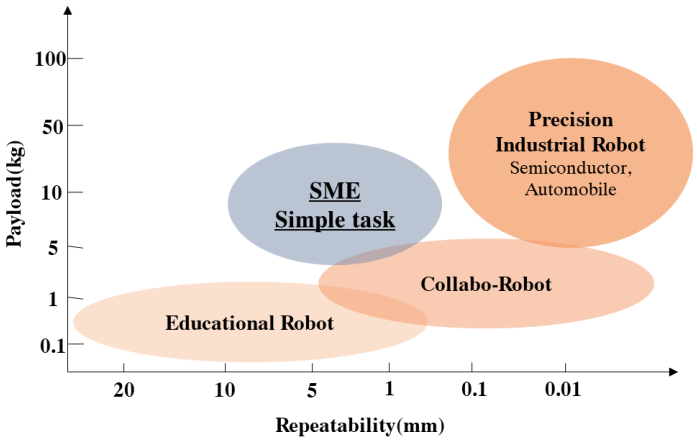
Global manufacturing robot growth prospects

➢ Robot market classification

- **Open Source Robot Market (Hobby, education)**
  - Focused on hobby, education
  - Low precision and payload under 1kg

- **Large industrial robot market**
  - Special purpose robots such as welding, heavy object transfer(safety fence)
  - High precision, payload, over 100 million won

- **Collaborative robot and medium-sized robot market**
  - Safe robot with collision detection and torque monitoring (no fence installed)
  - High precision, payload similar to human arm, over 20 million won

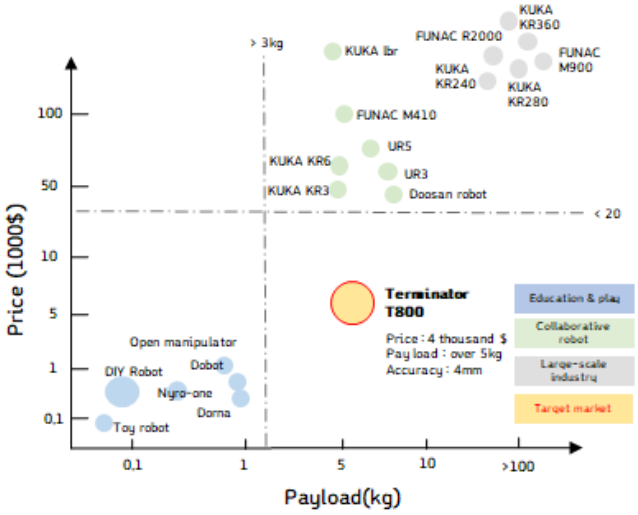


Robot repeatability-payload graph

3 Marketing strategy – target market

➢ Target market

- Collaborative robot and medium-sized robot market
  - **Larger payload** than educational robots (5kg)
  - **Lower precision** than commercial collaborative robots (4mm)
  - **Price: around 4 million**



➢ Competitor products in target market

- **Domestic manufacturer:**
  - High positioning accuracy, high payload, working radius within 800mm, high reduction ratio
  - Policies such as robot lease weakened price competitiveness
- **Overseas manufacturers:**
  - Elastic actuation to make flexible and safe robot, using a low rigidity exterior material
  - **high price and low payload**

Manufacturer	Neuromeca	RainbowRobotics	DoosanRobotics	Franka Emika	Rethink Robotics	ABB	Skynet
Model	Indy7	RB5-850A1	A0509	Panda	Sawyer	Yumi	Terminator T800
Price	₩38600,000	₩25,500,000	₩28,500,000	₩29,700,000	₩27,000,000	₩45,000,000	₩4,000,000
DOF	6 dof	6 dof	6 dof	7 dof	7 dof	14 dof	6dof
Payload	7 kg	5 kg	5 kg	3 kg	4 kg	0.5 kg	5kg
Repeatability	0.1 mm	0.1 mm	0.03 mm	0.1 mm	0.1 mm	0.02 mm	4mm
Work area	800 mm	850 mm	900 mm	855 mm	1260 mm	559 mm	800mm
Specifications	• Harmonic drive • Current-based collision detection	• Harmonic drive • KAIST lab start-up	• Harmonic drive • Torque sensor X	• Harmonic drive • Torque sensor O	• Planetary gear • Elastic actuator	• Two-armed robot • Soft exterior	• Improving repeatability through vision • Reduced speed ratio • Brainless robot

Neuromeca Indy7 | RainbowRobotics RB5-850A1 | DoosanRobotics A0509 | Franka Emika Panda | Rethink Robotics Sawyer | ABB Yumi | Skynet Terminator T800

3 Marketing plan

	R&D	Sales strategy	Marketing strategy
Short term	✓ Prototype development and production ✓ Verification through research project for small and medium-sized manufacturing companies ✓ Utilization of laboratory-based workshop (resource)	✓ Securing the market within the small and medium manufacturing industry ✓ Robot, AI education market ✓ Robot hardware sales ✓ Robot lease and educational materials sales ✓ Reinvestment after the initial startup fund recovery	✓ Reduce barriers to market entry through industry-academia-linked research projects ✓ Supply robots for educational purpose (Artificial intelligence classes in SNU) ✓ Promote crowdfunding platform
Long term	✓ Computer vision solution development ✓ Force control and complex assembly solution development ✓ Operation of robot farm ✓ AI data accumulation	✓ Vision Automation Solution Sales ✓ Solution sales (force control and assembly) ✓ Robot farm rental ✓ AI data sales	✓ Promote the developed smart factory with robots ✓ Expose Search Engine Optimization (SEO) keywords ✓ Promotion of use of SNS such as YouTube
	Lab-based product development	**Improve your sales strategy after market entry strategy**	**Industry-Academia cooperation and promotion**

Building a new type of ecosystem and creating value

4 Team member competency

Sungjin Hong

- M.S. Candidate in ME
- Worked with various types of collaborative robots
  (Doosan, KUKA, OpenManipulator, Dobot, ...)
- Computer vision
- Robot control
- Research in Smart Factory

Won-Jae Yun

- M.S. Candidate in ME
- Integration of AMR+Cobot
- Developing autonomous mobile robot
- Integrating co-operative robot

KyuHwa Lee

- B.S. in ME
- Reducer design
- ROS programming
- MCU control
- Computer vision
- Robot programming

Minyong Jung

- M.S. Candidate in ME
- Competency of mechanism & product design for 3D printing manufacturing

Inho Kee

- B.S. in ME
- Integrating ROS communication between robot and modules
  Design modular end-effector

Software

Hardware

SKYNET

TERMINATOR T800

COMING SOON
2020.10

Thank you

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