Case study for the socio-economic impact of large scientific projects on the technology transfer and technology-driven startups in KOREA

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Disclaimer: M. Kwon's personal views and assessments expressed herein do not necessarily reflect those of the Korean Government and NFRI.

Contents

Time lapse of KO Research Infrastructures

ALMA

Space launcher and launching facility

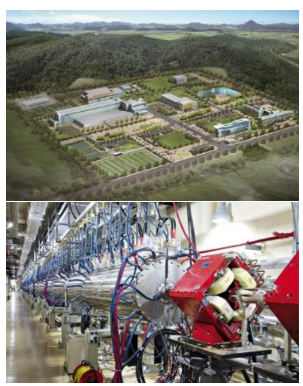
GMT

Superconducting tokamak

ITER

3rd generation light source

Proton accelerator



4th generation light source

Space exploration

Heavy ion accelerator

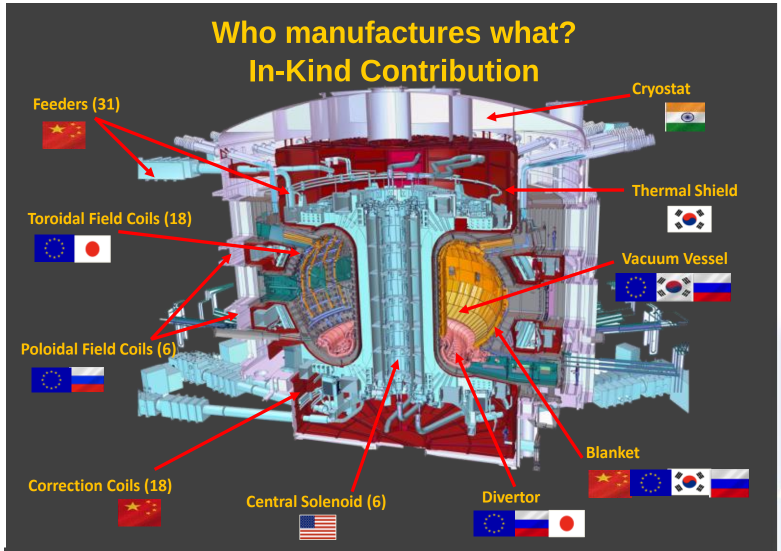
?

1995 | 2005 | 2015 | 2025

Contents

ITER Project

- ITER is aiming to demonstrate the feasibility to integrate the science, technologies, and safety features for a commercial fusion reactor;
- The self-sustained D-T burning plasma in ITER will generate 500 MW of power which is 10 times more than the input;
- ITER enterprise will create a new collaborative culture and standard for solving energy and environmental problems and contributing to the world peace;
- All of the intellectual properties obtained belongs equally to all seven Members.



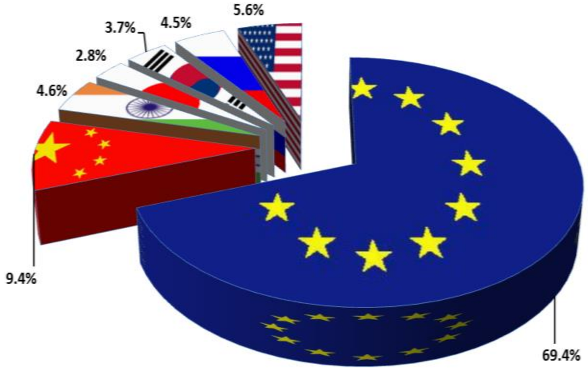
R=6.2 m, a=2.0 m, Ip=15 MA, Bt=5.3 T,
m=23,000 tons, (H) 29.0 m x (D) 28.6 m

◆ ITER Organization & Seven Domestic Agencies

- The 7 ITER Members make in-cash and in-kind contributions to the ITER Project. They have established Domestic Agencies.

● Human Resources (as of Oct 2017)

- ITER Organization (IO) has 808 staff members, including 531 Professional staff and 277 General staff.



IO Staff G, P & higher categories by Member

Status of ITER Construction

- **% Complete** for FP installed Capital Item Components (March 2018):
  - 54.2% complete including IO assembly & installation;
  - %Achieved/%Planned generally stable from mid 2017 and reported at 0.87;

Unique Features and Challenges of ITER Project

- **International Research Infrastructure <u>under Construction</u>**
  - **The ITER project is for constructing a single-sited International Research Infrastructure with integration of distributed resources via in-kind contributions by Member's Domestic Agencies (DA).**
  - **The ITER project has five distinctive Phases in its project life cycle, which are Design, Construction, Operation, Deactivation, and Decommissioning, and now it is under the Construction Phase.**
  - **A number of stake-holders: there are various different views on the project.**
  - **In-kind procurement system: there are so many (technically not only rigid but also soft) interfaces.**
  - **Quality is a key concern on how to control and manage the integration of in-kind components/system.**

- **<u>First-of-a-kind Fusion Device</u> -> Technical Challenges**
  - **Design of a certain key components is not completely frozen until now. Design of some components is still on-going.**
  - **There are no explicit lessons learned on a number of technical issues. The mechanism of decision making was used to be too late, but now is improving.**

- **ITER is a Basic Nuclear Installation in French Regulations -> Safety Requirements**
  - On **9 November 2012**, French Prime Minister signed the official decree that authorizes the ITER Organization to create the ***Installation nucléaire de base*** **(INB No.174) ITER**.

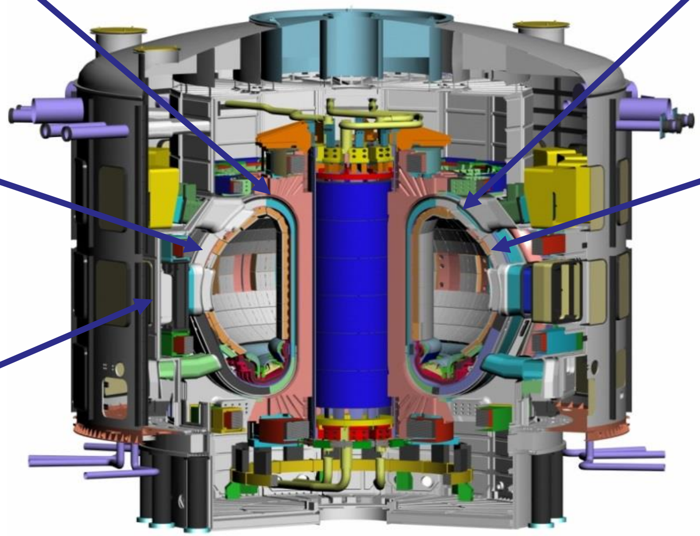
In-kind Contribution of Korea

1. TF Conductor (Completed)
Total Value (kIUA) : 215.01
KO Allocation : 20.2%
KO Contribution (kIUA) : 43.39

Test Blanket Module*
KO Contribution :
HCCR TBS (TBM System)
kIUA Value : N/A

4. Thermal Shield
Total Value (kIUA) : 26.88
KO Allocation : 100%
KO Contribution (kIUA) : 26.88

2. Vacuum Vessel Main Body
Total Value (kIUA) : 118.51
KO Allocation : 21.3%
KO Contribution (kIUA) : 25.20



5. Blanket Shield Block
Total Value (kIUA) : 56.34
KO Allocation : 49.8%
KO Contribution (kIUA): 28.07

3. Vacuum Vessel Port
Total Value (kIUA) : 76.98
KO Allocation : 72.9%
KO Contribution (kIUA) : 56.13

6. Assembly Tooling
Total Value (kIUA) : 18.45
KO Allocation : 100%
KO Contribution (kIUA): 18.45

7. Tritium SDS
Total Value (kIUA) : 12.51
KO Allocation : 94.2%
KO Contribution (kIUA) : 11.79

8. AC/DC Converters
Total Value (kIUA) : 122.61
KO Allocation : 37.1%
KO Contribution (kIUA): 45.58

9. Diagnostics
Total Value (kIUA) : 205.66
KO Allocation : 2.0%
KO Contribution (kIUA) : 4.11

* TBMA (TBM Arrangement) was signed in 2014.

Total Value : 259.60 kIUA

Case Study of ITER KO Project

- **Basis of impact assessment of ITER KO Project**

  - **Although the primary objective of Research Infrastructures is to produce cutting edge science [and technology], their impact goes beyond scientific horizon usually.**
  - **Research Infrastructures require advanced technological developments, fast data network, high-level researchers and engineers, [as well as high-tech goods and high-quality engineering services from industries] and therefore can give considerable social and economic impact.**
  - **As the demand (and probably the cost) of Research Infrastructures for better research and development increases [for users], so is the demand for better socio-economic assessment [for funders].**

- **In this case study of the ITER KO Project, most of the analysis on the data (2006-2016) is referenced with the result of impact assessed by SJS consultation firm in 2017, and the presentation is divided into three sets of categories with relevant indicators.**

  - **Indicators of Scientific and Technical Performance Assessment of ITER KO Project**
  - **Indicators of Social Impact Assessment of ITER KO Project**
  - **Indicators of Economic Impact Assessment of ITER KO Project**

2.1 Scientific and Technical Performance Assessment

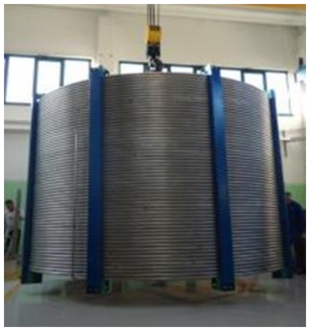
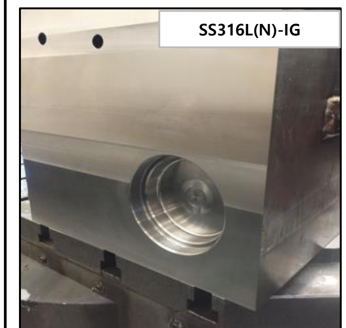
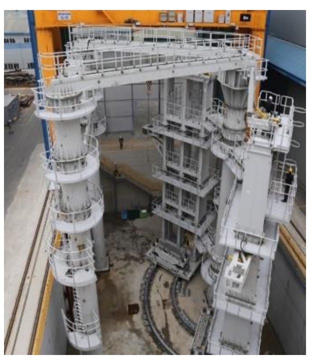
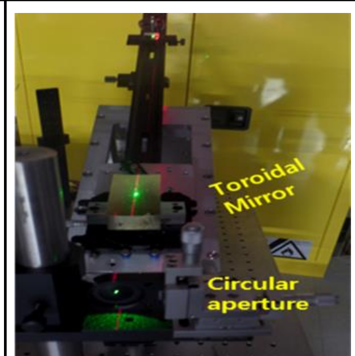
Indicators of Scientific & Technical Performance Assessment

- The primary mission of the ITER KO Project (a partner of the ITER international Research Infrastructure) is to provide cutting edge fusion science and technology in a way to develop the ITER, a prototype experimental device for commercial fusion reactor in the future.
  - Periodic performance assessment of the ITER KO Project is compulsory by demand of the funder (KO Government), in order to review whether the Project mission would be met or not.
  - To assess performance of the Project, appropriate indicators are required (should be developed) and their scorecards are important to judge the funder's investment decision.

- In this case study of the ITER KO Project, indicators of scientific and technical performance assessment are as follows;
  - % Complete of the Project (direct, quantitative)
  - Contribution to elevating the level of the Korean fusion R&D technical tree (direct, qualitative)
  - Publication of papers (direct, quantitative)
  - Citations of papers (direct, quantitative)
  - Patents (direct, quantitative)
  - Technology transfer (In-direct, qualitative)

% Complete of ITER KO Project

- **Overall Physical Progress of KODA In-kind Procurement Activities is recorded as about 59.2% in December 2017, advanced by ca 14% since December 2016. (Target: 100% in 2025)**

TF Conductors	Vacuum Vessel Sector	Vacuum Vessel Ports	Thermal Shield	Blanket Shield Blocks
				
100.0%	77.9%	35.2%	60.5%	22.7%
Assembly Tools	**Tritium SDS**	**AC/DC Converters**	**Diagnostics**	Average about **59.2** % (as of December 2017) (Activity Progress as per Item × Weight of its kIUA)
				
80.5%	12.9%	67.2%	30.2%	

Contribution by ITER KO Project to elevating the level of the Korean fusion R&D technical tree

ITER Construction Phase | ITER Operation Phase | Current Level (Dec. 2017)

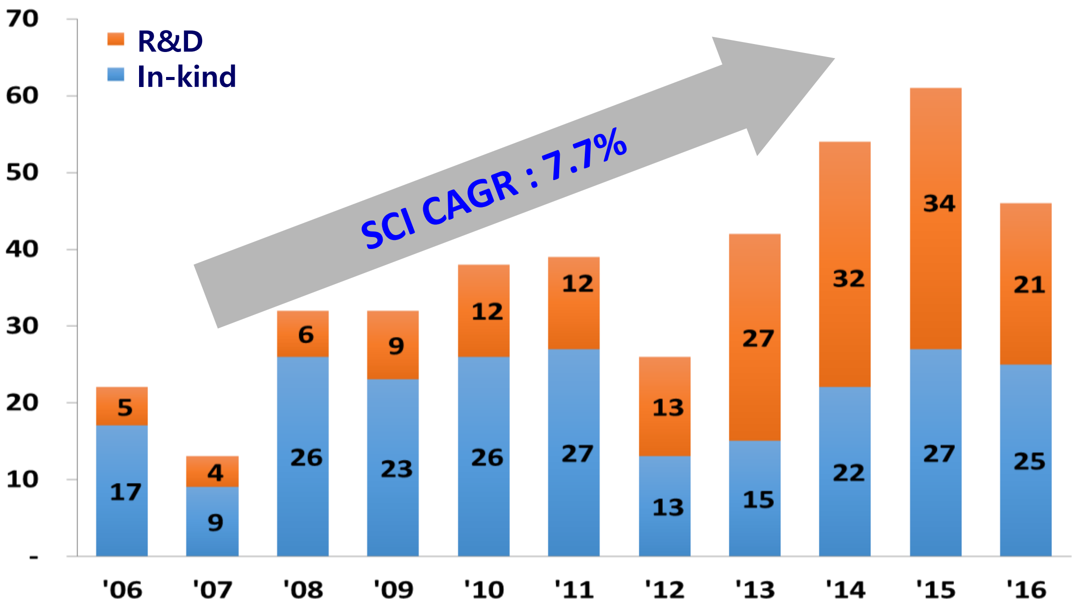
Technical Area	Core Technology	Current Level versus Commercial Reactor Tech. (43.9%)	Level of Fusion Technology up to Commercialization																										
			1			2			3			4			5			6			7			8			9		
			1-1	1-2	1-3	2-1	2-2	2-3	3-1	3-2	3-3	4-1	4-2	4-3	5-1	5-2	5-3	6-1	6-2	6-3	7-1	7-2	7-3	8-1	8-2	8-3	9-1	9-2	9-3
Reactor Plasma Physics	1. Burning Plasma Physics	48.1%													13														
	2. Burning Plasma Simulator	37.0%										10																	
	3. Integrated Plasma Control	48.1%													13														
Reactor System Integration	4. **Integrated Reactor Design**	48.1%													13														
	5. Assembly	55.6%															15												
	6. Handling & Maintenance	44.4%												12															
	7. **Vacuum Vessel** & IV Components	59.3%																16											
	8. Fueling	48.1%													13														
	9. CODAC and I&C	63.0%																	17										
	10. Cryogenic Distribution	59.3%																16											
	11. Project Management	63.0%																	17										
	12. Fusion Buildings & Facilities	63.0%																	17										
Superconducting Technology	16. Superconducting Magnets	55.6%															15												
	17. **Superconducting Strands**	66.7%																		18									
	18. Magnet Feeders	55.6%															15												
	19. Magnet Case Structure	59.3%																16											
Fusion Materials	22. **Structure Materials**	33.3%									9																		
	23. Plasma Facing Components	33.3%									9																		
	24. Breeding Materials	44.4%												12															
	25. Irradiation Tests of Materials	22.2%						6																					
	26. Cooling Materials	40.7%											11																
Fuel Cycle Technology	31. **Tritium Extraction System**	18.5%					5																						
	32. Vacuum Pumping System	40.7%											11																
	33. Tritium Purification	40.7%											11																
	34. Isotope Separation	37.0%										10																	
	35. Tritium Storage System	40.7%											11																
	36. Tritium Delivery System	40.7%											11																
Safety & License	37. Fusion Safety Tech.	37.0%										10																	
	38. Fusion Licensing Tech.	37.0%										10																	

Papers published from the ITER KO Project

- **SCI Papers (2006-2016): 404 published**
  - grade-S: 237 (58.7%)
  - 230 (56.9 %) papers related to in-kind procurement and 174 (43.1%) related to ITER R&D.
- **Compound Annual Growth Rate (CAGR): 7.7%**

- **Paper Quality: High Impact Factor**
  - Average Modified Rank Normalized Impact Factor (mrnIF) (※ an indicator by MSIT (2014))
  - mrnIF Score (2011-2015)
    ITER KO Project: 64.1 > Nation-wide R&D: 61.6
    (※ Score of grade-S paper: 80.0)

  [Sources: SJS report (2017), KISTEP report (2017)]



SCI papers published from ITER KO Project

- **Paper Productivity per 1 M$**
  - ITER KO Project: 0.49 paper per M$
  - in comparison with
    ※ National R&D (average): 0.52 per M$
    ※ Big Science: Radiation R&D: 0.11 per M$, KO Rocket Launching R&D: 0.07 per M$

  [Sources: SJS report (2017), NTIS homepage]

Citations of papers from the ITER KO Project

Citation of SCI Papers (2006-2016)

- **ITER KO Project (404 papers): average 4.4 per paper**

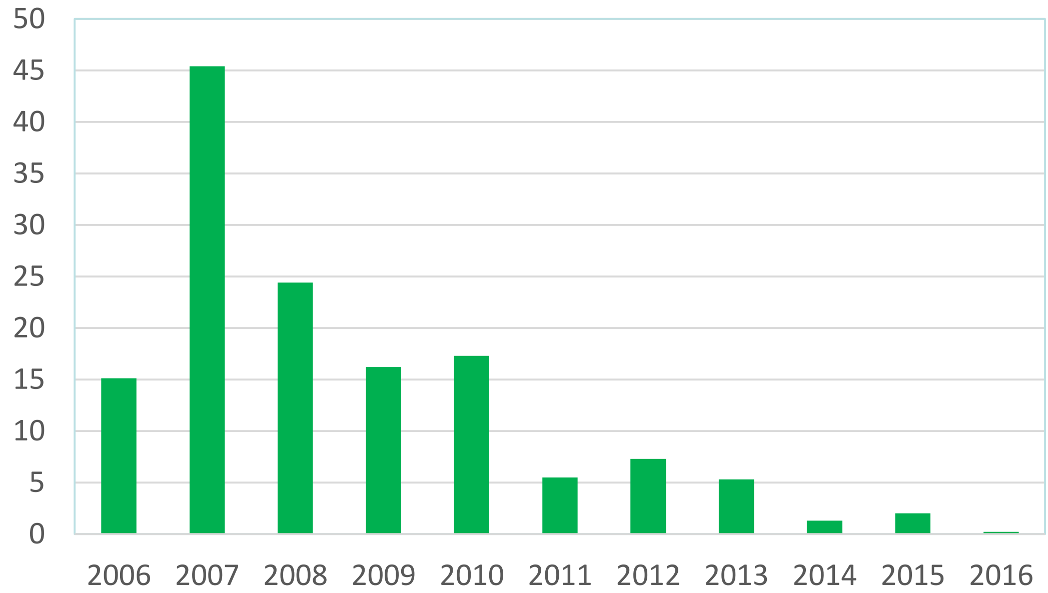
  cf) KSTAR Project (877 papers): average 3.7 per paper (2017)

- **Average citations per paper during 2011-2015**

  ※ ITER KO Project: 2.2 > Nation-wide R&D: 0.57

  [Sources: SJS report (2017), KISTEP report (2017)]

Annual Citation of SCI Papers from ITER KO Project

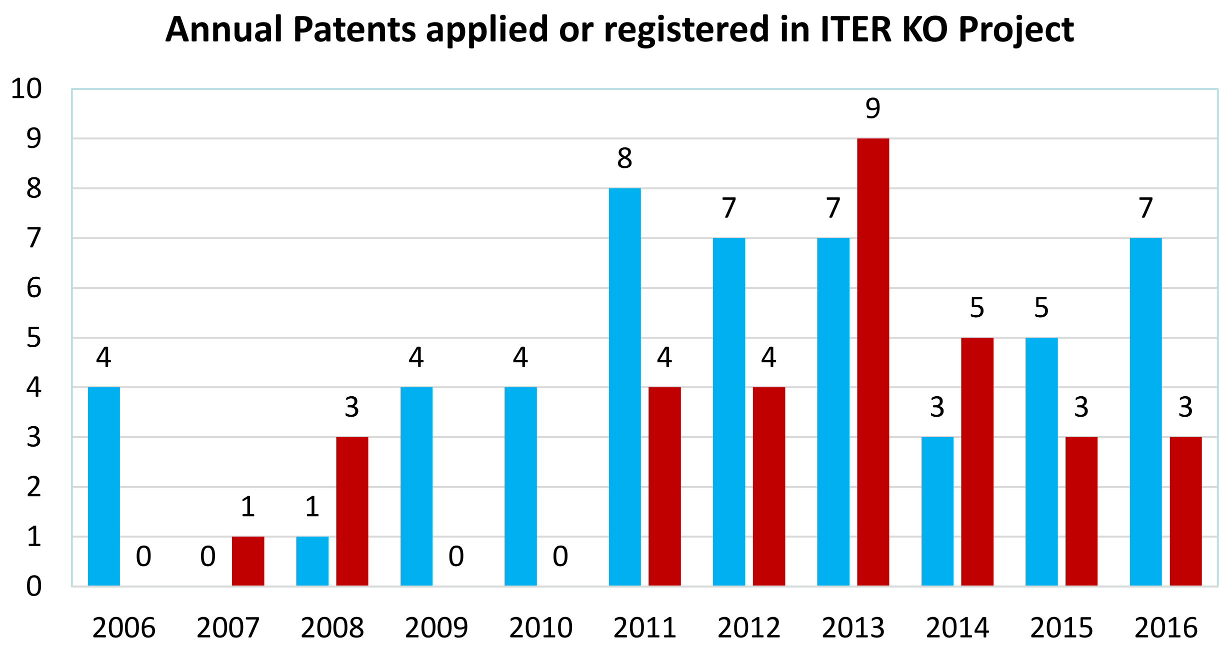


Patents applied or registered in ITER KO Project

Patents (2006-2016)

- **Patent Application: 50 (international Application: 2)**
- **Patent Registration: 32**
- **Ratio = Registration/Application = 64%**

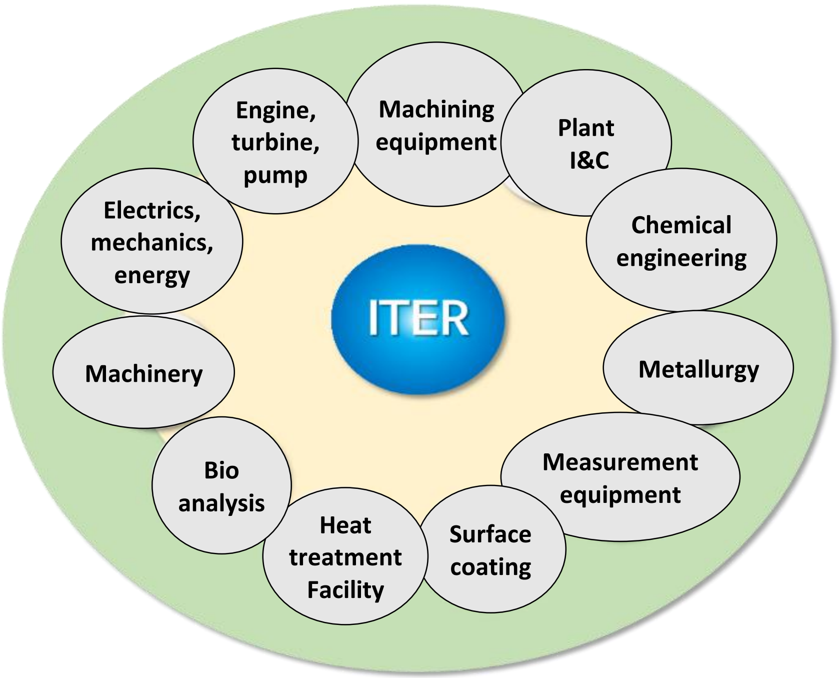
- It is assessed to be a relatively high value in comparison with other R&D output.



Technology transfer during ITER KO Project

- **Technology transfer from ITER KO Project (In-direct performance and qualitative assessment)**
  - Technology-transferred sectors: Machining equipment; Plant I&C; Chemical engineering; Metallurgy; Measurement equipment; Surface coating; Heat treatment facility; Bio analysis; Machinery; Electrics, mechanics, energy; Engine, turbine, pump; etc.
  - Technology-transferred disciplines: Aero-space, Radiation R&D, Accelerator, Medical Mechatronics, etc.

Technology transfer by ITER KO Project



[Sources: SJS report (2017)]

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2.2 Social Impact Assessment

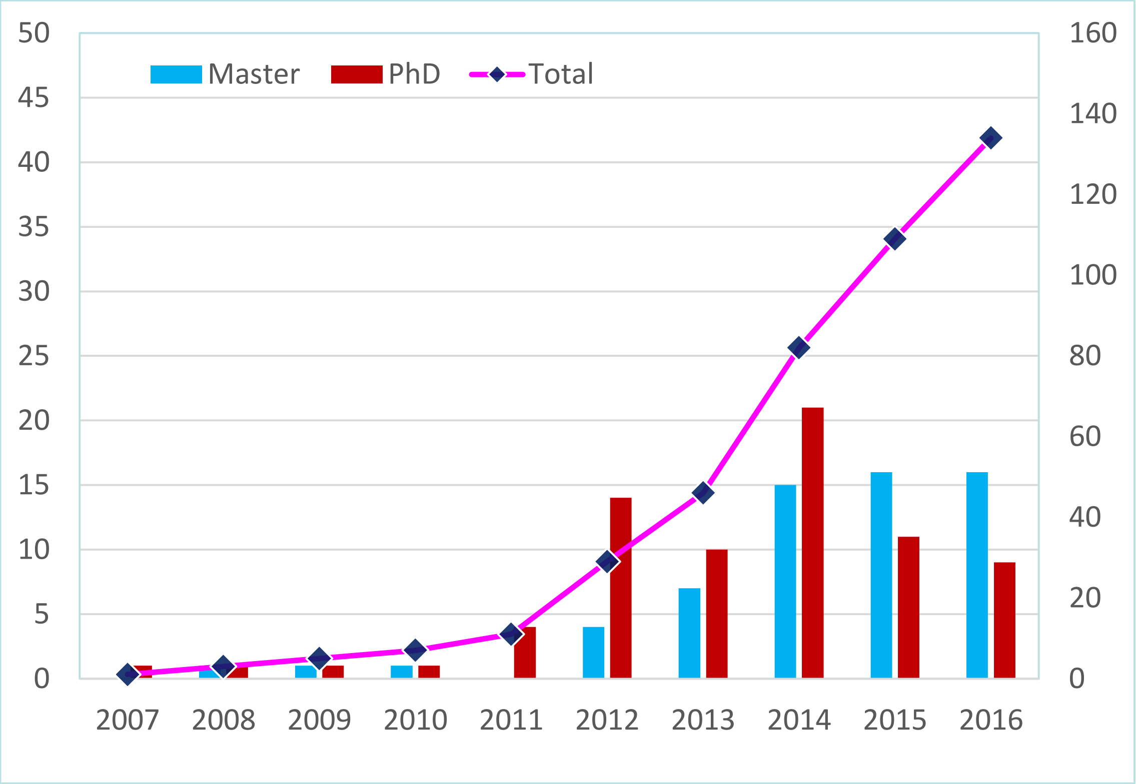
Indicators of Social Impact Assessment

- While the performance and quality of scientific and technical output are the primary objectives of the ITER KO Project, social added values are also demanded from the Project in order to justify its investment by the funder (KO Government).
  - Periodic social impact assessment of the ITER KO Project is not compulsory, but the funder often requests the social added values especially when they need to explain on the effectiveness and public benefit of its investment for the tax payers.
  - To assess the social impact of the Project, appropriate indicators are important.

- In this case study of the ITER KO Project, chosen indicators for social impact assessment, taking into account features of the Project, are as follows;
  - #Students trained (fostering human resources, direct, quantitative)
  - #Secondment to the ITER Organization (fostering fusion engineers, direct, quantitative)
  - Technical innovation of industries (in-direct, qualitative)
  - Added value to the brand of industries (in-direct, qualitative)
  - Support to industries in resolution of technical issues (in-direct, qualitative)
  - Intellectual properties generated by industries (in-direct, qualitative)

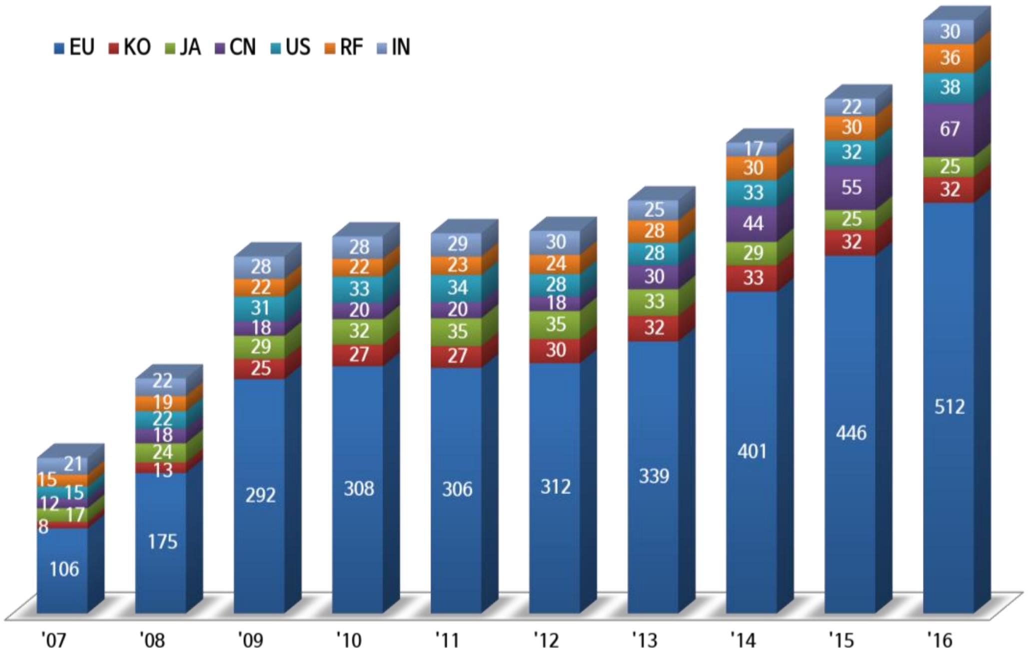
Students Trained by ITER KO Project

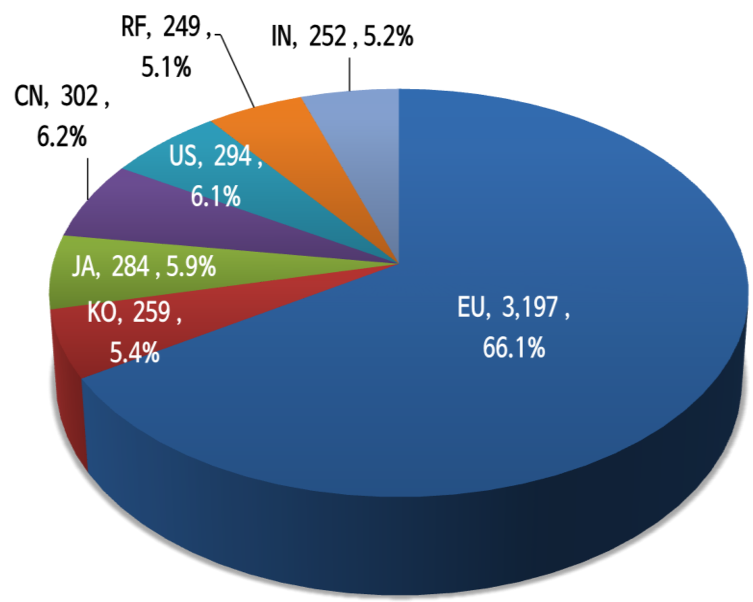
- **Master & PhD student trained by the ITER KO Project: 134 students (2006 – 2016)**
  - **This social impact is expected to foster Korean young fusion scientists and engineers who will become the qualified human resources for development of fusion power plant in the future.**



Secondment to the IO via ITER KO Project

- **Secondment of Korean engineers to IO (2006 – 2016)**
  - 5.4% (KO staff of 259 out of IO staff of 4,837 during 2006 – 2016)
  - EU (66.1%), CN (6.2%), US (6.1%), JA (5.9%), KO (5.4%), IN (5.2%), RF (5.1%)
  - This social impact is important for Korean fusion scientists and engineers who have experienced the ITER construction, after their terms at the IO, shall be key leaders in the development of fusion power plant in the future.



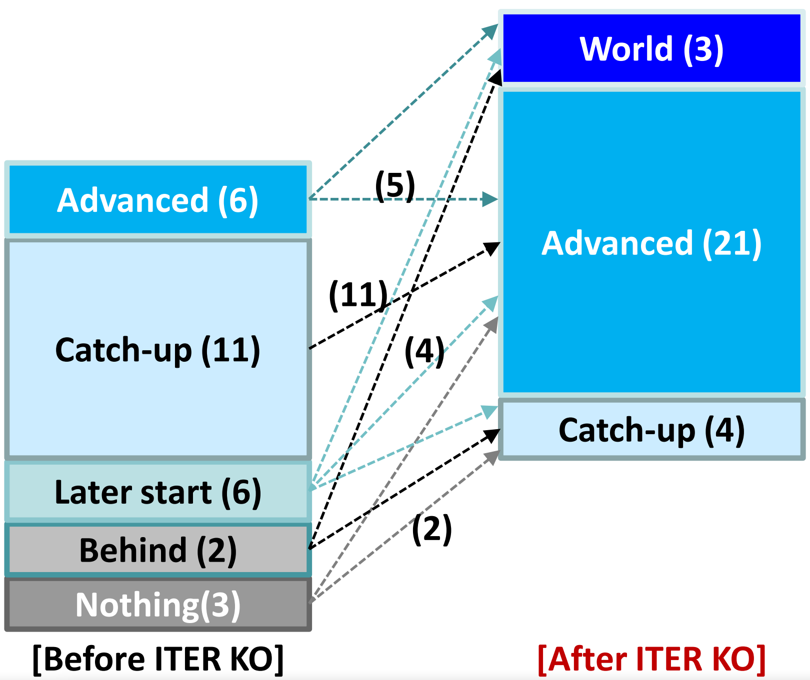


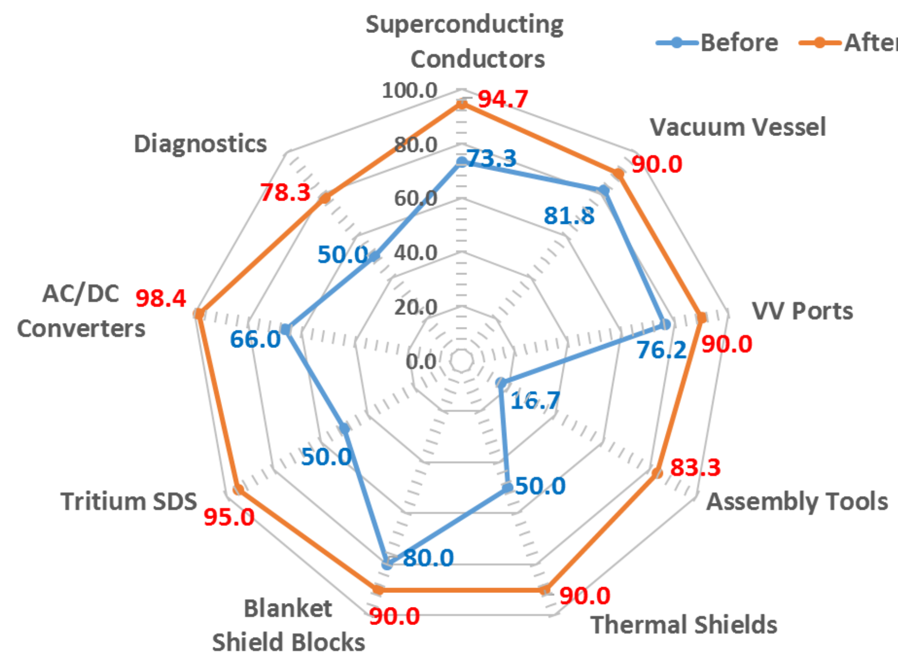
Technical Innovation of Industries

Technical Innovation of Industries (2006-2016)

- **At survey, the technical competition of some industries has been grown up to the level of world class.**
  - After their participation in the ITER KO Project, the technical competition level of most of industries has been escalated from 60% to 90% compared to the world top level.
  - ex) Assembly tooling company: 15% → 83%, Thermal shield company: 50% → 90%,

[Sources: SJS report (2017) by survey on industries]



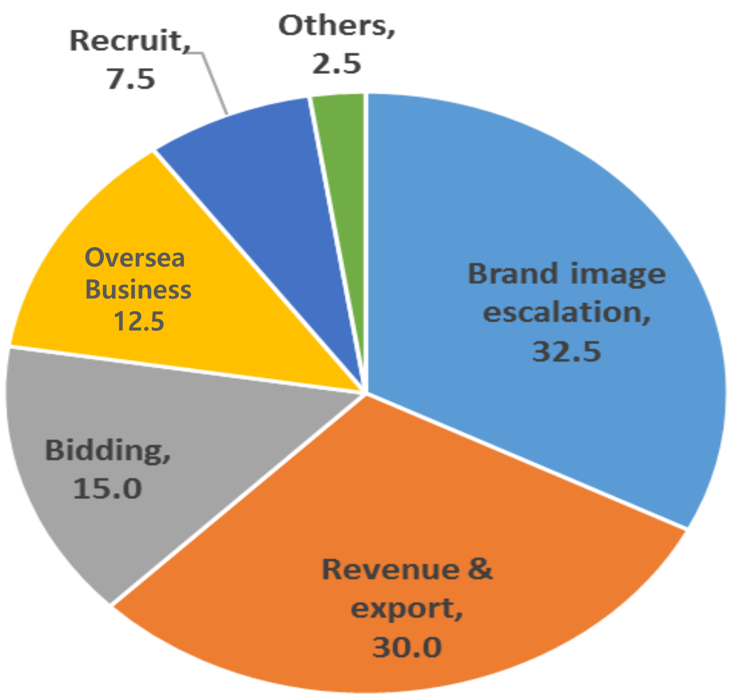


Added Value to the Brand Power of Industries

Added Value to the Company Brand Power (2006-2016)

- **At survey, company brand powers are value-added through participation of the ITER KO Project, in which this impact results in;**
  - ① company brand image escalation (32.5%), ② increase of revenue and export (30.0%), ③ increase of winning rate at the other project biddings (15.0%), ④ oversea business (12.5%)

[Sources: SJS report (2017) by survey on industries]



Support to Industries in Resolution of Technical Issues

Support to Industries in Resolution of Technical Issues (2006-2016)

- **At survey, some companies had resolved their long-standing technical problems or new technology issues in consultation with experts in the ITER KO Project.**

  - ex) converter design optimization, converter controller algorithm, structure analysis, breeding pebble (Li_2TiO_3) fabrication, vacuum vessel ports, DU beds, quality plan and control, etc.

[Sources: SJS report (2017) by survey on industries]

IPs Generated by Industries via ITER KO Project

- **Companies who have generated intellectual properties through the ITER KO Project would take high competence in exploring new markets by applying similar goods and services.**

  - Patents: 25 (Application 16, Registration 9)

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2.3 Economic Impact Assessment

Indicators of Economic Impact Assessment

- The realization of the economical reward from the investment of the ITER KO Project takes inherently a long term so that the economic impact assessment is limited to short/mid-term effects of the Project.

  - Even though the economic short or mid-term impact is not final goal for investment, the funder (KO Government) always expects it and demands the economic impact values especially when they need to justify their investment for the tax payers.
  - It is not easy to assess the economic impact of the (scientific) ITER KO Project, because there is no direct economic output until completion of its mission except some short-term side-effects, and furthermore, the assessment tools of the economic impact are sometimes very conceptual.

- In this case study of the ITER KO Project, chosen indicators of economic impact assessment, taking into account the Construction Phase of the Project, are as follows;

  - Investment cost(direct, quantitative)
  - Turnover of industries (direct, quantitative (indicative))
  - Cost-benefit of investment (in-direct, quantitative)
  - Created jobs in industries (socio-economic, direct & in-direct, quantitative and qualitative)
  - Created new and/or potential business in industries (in-direct, indicative and qualitative)
  - Support to competiveness of small-mid enterprisers (in-direct, qualitative)

Investment to ITER KO Project

- Investment to the ITER KO Project (2006 – 2025)

Period	ITER Contributions		Total
	In-kind	In-cash	
2006 – 2016 (achieved)	506.2 M$	223.2 M$	729. 5 M$
2017 – 2025 (projected)	344.4 M$	528.4 M$	872.8 M$
Sub-total (Current Value as of 2017)	850.6 M$	751.7 M$	1,602.3 M$

Turnover of Industries via ITER KO Project

● Turnover of Industries via the ITER KO Project (2006 – 2025)

Subject	Achieved (2006 - 2016)	Projected (2017 - 2025)	Total
Ordinary Value	714.5 M$	1,386.9 M$	2,101.4 M$
Current Value As of 2017	868.3 M$	1,183.1 M$	2,051.4 M$

◆ Main markets for turnover of industries

- In-kind Procurement of KO-DA
- Procurement and Installation of the IO
- Related Markets (public as well as commercial)

[Sources: SJS report (2017)]

Cost-benefit of Investment of ITER KO Project

● **Cost-benefit Assessment of the ITER KO Project (2006 – 2025)**

- Total input : 1,690.4 M$ (current value as of 2017)
- Total turnover: 2,051.4 M$ (current value as of 2017)
- (simplified) Index of cost-benefit = Output Turnover / Input Cost = 1.2

Subject	Total Input Cost (current value)	Total Turnover (current value)	Index of cost-benefit
Total	1,690.4 M$	2,051.4 M$	1.213
Achievement (2006 -2016)	983.2 M$	868.3 M$	0.883
Projection (2017-2025)	707.2 M$	1,183.1 M$	1.673

[Sources: SJS report (2017)]

Created Jobs in Industries via ITER KO Project

Created Jobs in Industries (2006 – 2025)

Achievement (2006 - 2016)	Projection (2017 - 2025)	Total
7,171 FTE	10,932 FTE	18,103 FTE

Note)

1) Based on survey on industries (mainly achievement)

2) Employment assessment guideline (Minister of Labor of Republic of Korea)

ex) manufacturing labor: average 0.94 FTE per 100 k$ (mainly projection)

[Sources: SJS report (2017)]

Created New Business in Industries from ITER KO Project

● Created New Business in Industries

- Industries had created additional revenues of 44.6 M$ (including the export of 2.8 M$) in other markets, based on their experience in the ITER KO Project.
- Afterwards, it is expected to create further markets of about 190.7 M$ (including the export of 80.0 M$) in the areas of Accelerator, Aero-space, etc., utilizing the technologies applied for ITER. (Superconducting magnet, AC/DC power supply, Diagnostics, Vacuum Vessel, etc.)

[Sources: SJS report (2017) by survey on industries]

Support to Competiveness of small-mid Enterprisers by ITER KO Project

● Support to Competiveness of small-mid Enterprisers

◆ Most of small-mid enterprisers who participated in the ITER KO Project responded on the survey such that;

- They had enhanced their capacity in terms of human resource and their quality of manufacturing (human resources of about 30% are working for ITER KO Project)

- They had grown up to be competitive in high-tech markets, especially companies who participated in the areas of superconducting, engineering analysis, assembly tools, etc.

- What they established or expanded solely for implementation of the ITER KO Project;
  - spin off company: 1,
  - affiliated Research Institution: 1,
  - new departments (quality control, manufacturing, engineering, etc.): 4

[Sources: SJS report (2017) by survey of industries]

Contents

History

1955~1999

with the name of

Kwangmyeong Electronics

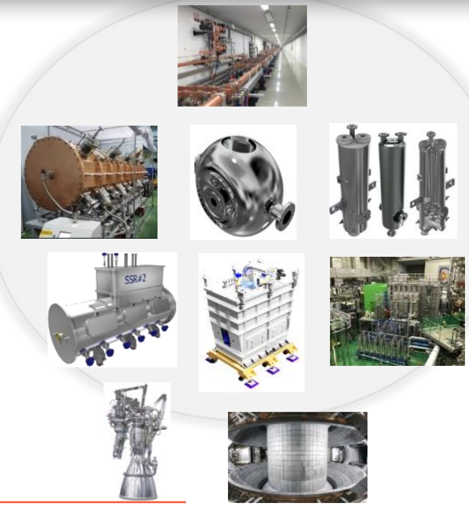
- Vacuum Interrupter
- Insulation
- High Power Breaker
- Power Distribution
- RF Input Coupler (1997)

2000s ~ VITZROTECH

Listed on KOSDAQ (Korean Stock Market)

➢ Start Accelerator & Nuclear Fusion And Aerospace Business

- Manufacture of 350MHz, 2.5MV DTL Proton Accelerator
- Manufacture of High Power RF Klystron Component
- Manufacture of 350MHz, 4MV & 100MeV Proton Accelerator DTL
- Rocket Combustion Chamber & 30Ton Grade Rocket Engine Gas Generator



2010s ~ Total Solution for Accelerator & Nuclear Fusion

➢ 4th Generation Photon Accelerator

- Accelerator Column, Waveguide, Beam Line Component

➢ Heavy Ion Accelerator

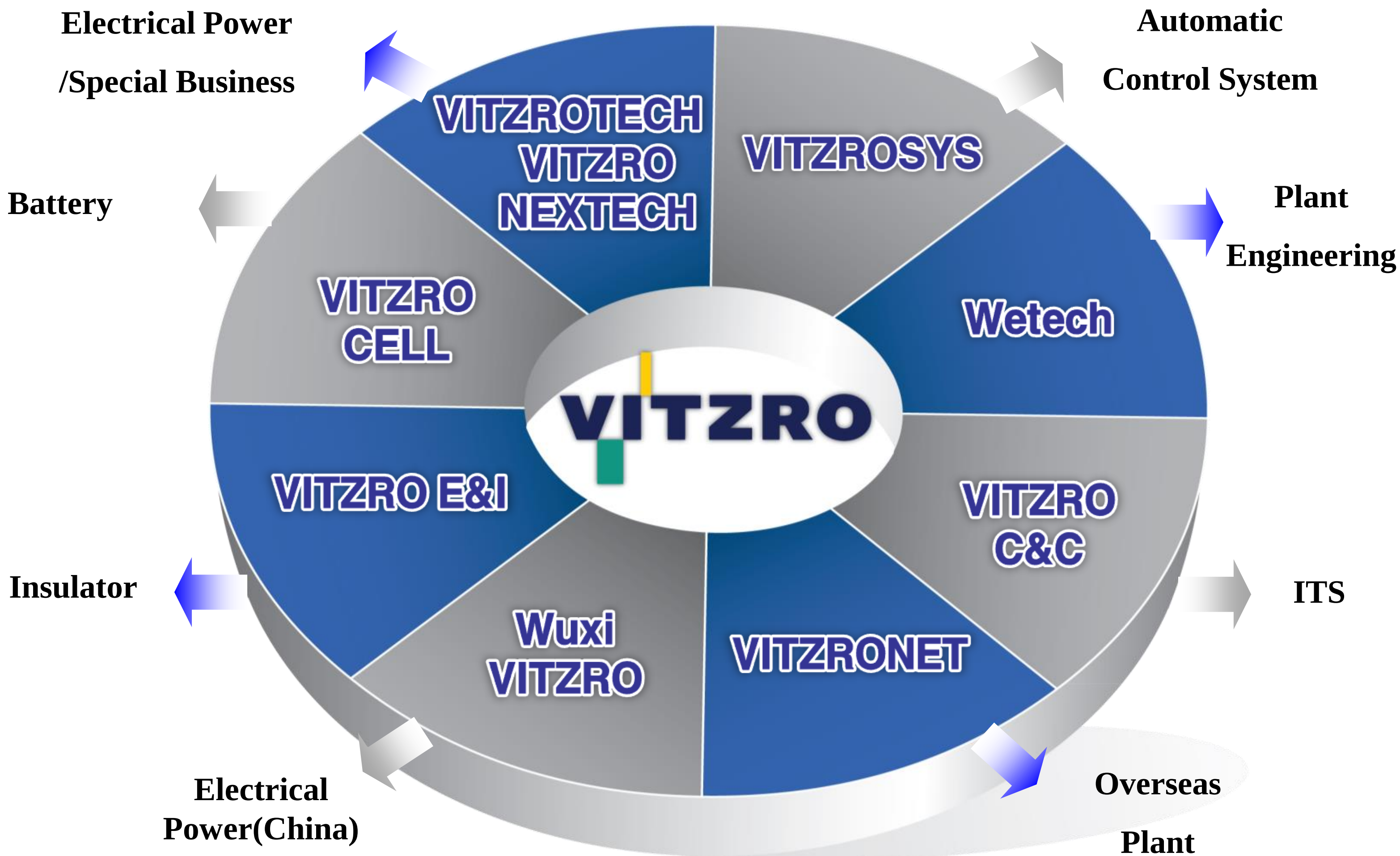
- SRF Cavity, QWR, HWR, SSR Cryomodule, SSR Cavity

➢ Nuclear Fusion Device, Facility, Component

- NBI-I, NBI-II, PFC, Ion Source

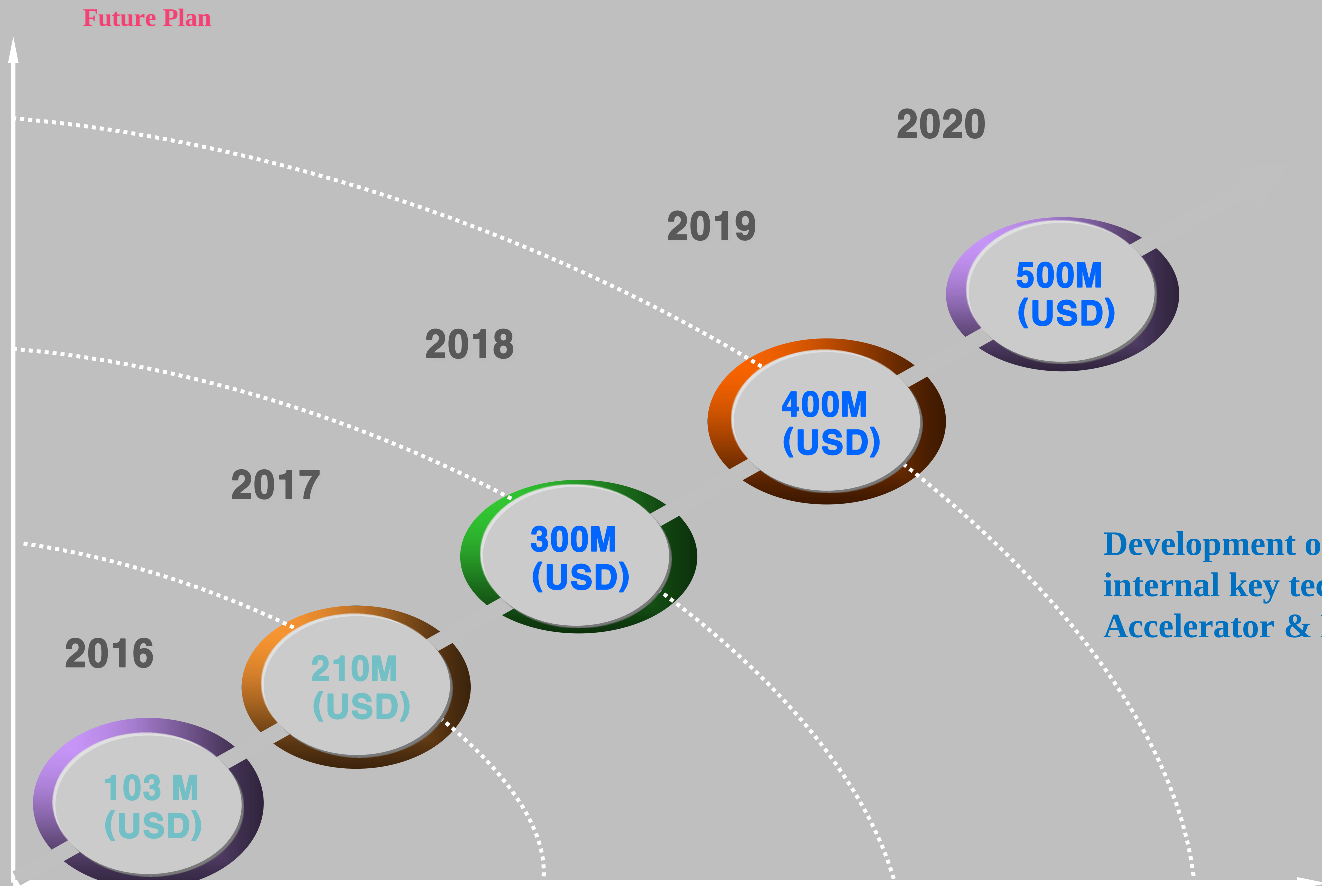
➢ Cryogenic

- Distribution System (DB Box, Transfer Line, Control)
- Rocket Engine Combustion Chamber (75ton Grade)



- Group Turnover : 370million USD
- Number of Employee : 1,270

Turnover (Development of Sales - Growth)



Development of industrial parts through internal key technology in field of Accelerator & Nuclear Fusion

Accelerator
Nuclear Fusion
Plasma
Aerospace

\+

Medical Device & Component
Semiconductor
Defense

\+

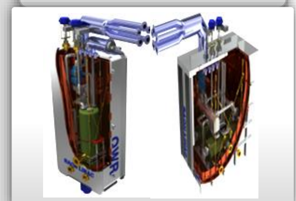
Communications System
Industrial Vacuum part

Current Business Scope

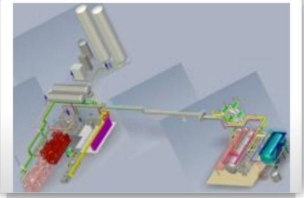
Accelerator

Photon Accelerator

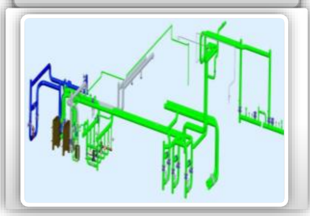

Proton Accelerator


Heavy Ion Accelerator


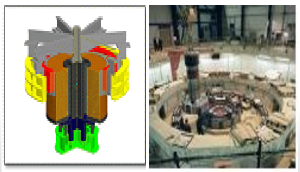
Cryogenic

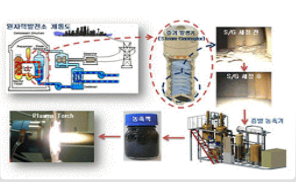
Cryo-plant


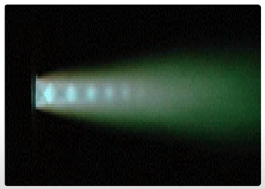
Cryomodule


Cooling system


Plasma Application

Nuclear Fusion


Radioactive Treatment


Plasma Torch


Aerospace

Rocket Engine

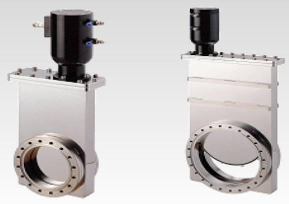

Test Facility


H.P Oxidizer Piping


Vacuum System

Vacuum System


Semiconductor


Vacuum Gate valve


Electric Power

High Power Breaker


Power Distribution


VI


Insulation


VITZRO TECH

All these exploration starts from this small piece!

History

1996 — 2004 — 2006 — 2008 — 2010 — 2016

Fusion & Accelerator R&D

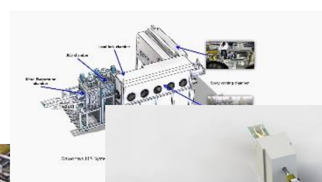
- 1998.03. Power Supply R&D for KSTAR
- 2004.01 Power supplies for KSTAR magnets
- 2009.05. KSTAR NBI1-A, LHCD P/S
- 2009.10. PAL PLS-II MPS P/S
- 2011.08. ITER P/S Procurement
- 2012.04 KSTAR RMP P/S
- 2012.06. PAL XFEL MPS
- 2012.10. KBSI LEBT MPS
- 2013.01. P/S for Japanese iBNCT
- 2013.06. KIRAMS Dipole MPS
- 2017.06. High precision CCPS for Chinese SINAP
- 2017.12 KSTAR TF SDC & QP Helicon P/S

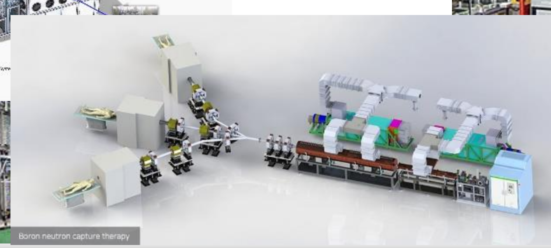
Commercial Products

- 2002.06 Induction Heater Developed
- 2004.01 Induction Heater for POSCO
- 2005.01 Rectifier Produced
- 2006.01 AP Power Supply
- 2007.11. Rectifiers for Vietnam Steel Company
- 2008.11. P/S for POSCO
- 2011.03. LCD Plasma Device for SAMSUNG
- 2011.12. Inverter for trains of Seoul Metro
- 2015.03. Won the Seoul Metro train bid
- 2016.05. Controller for Busan Metro train
- 2017.06. Won the Seoul City Metro train bid

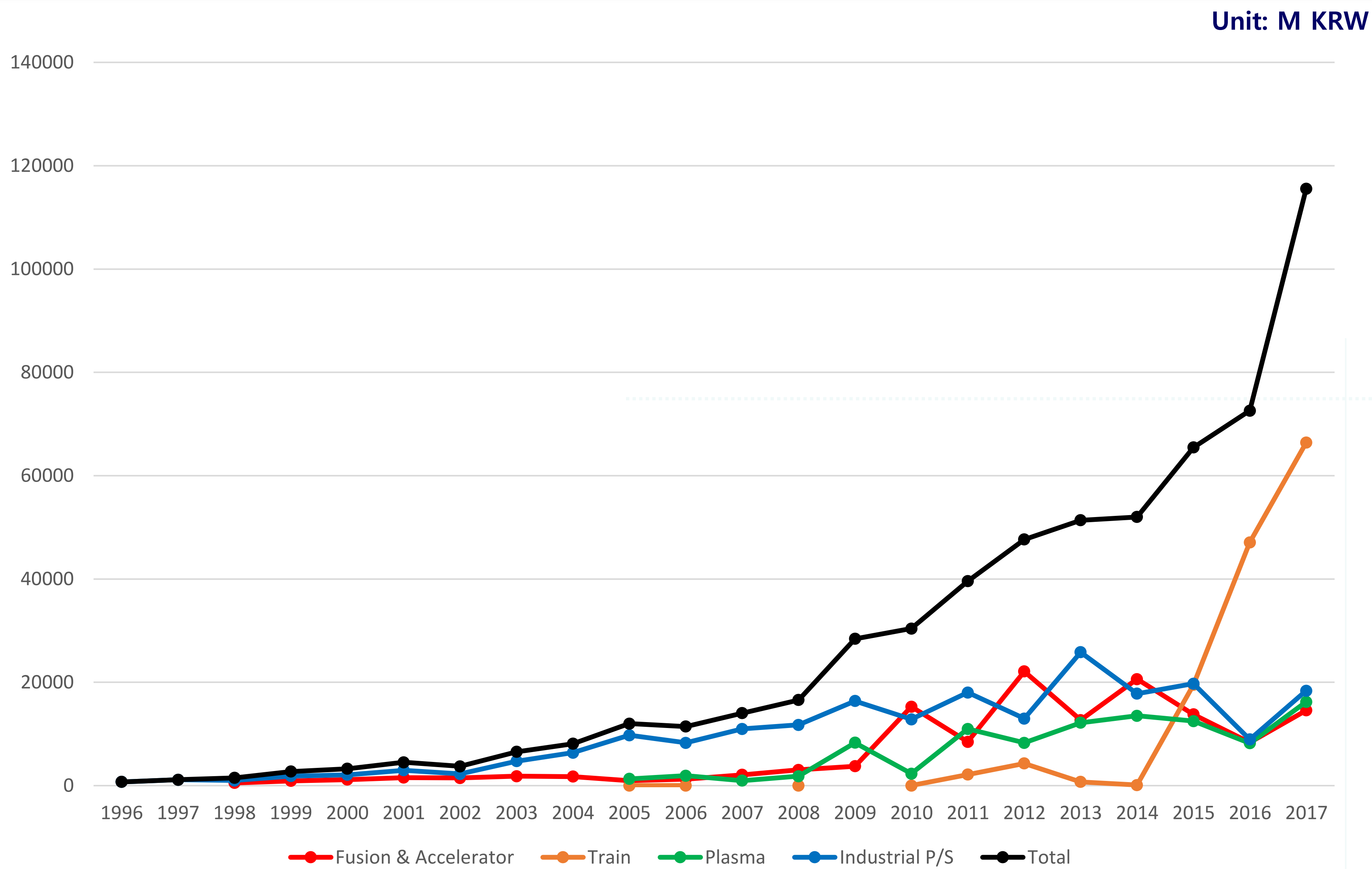
Corporate History

- 1996.01. Established
- 2005.03. ISO 9001
- 2007.10. ISO 14001
- 2010.09. Listed on KOSDAQ
- 2010.10. New Corporate Building
- 2014.05. World Class 300
- 2015.09. Launch BNCT business
- 2017.06. Received the 9th KOSDAQ Awards





Turnover (1996~2017)



Collaborative R&D with Institutes

No.	R&D Institutes	Projects
1	National Fusion Research Institute	ABNCT Injector R&D
2	National Fusion Research Institute	ABNCT Proton Accelerator commissioning
3	National Fusion Research Institute	K-BNCT Proton Accelerator conceptual design
4	POSTECH	BNCT ECR Ion Source R&D
5	POSTECH	High Precision Power Supply R&D
6	POSTECH	High Voltage, High Precision CCPS for XFEL Modulator R&D
7	POSTECH, GACHEON Univ., GHIL Hospital, KAERI, KBSI	ABNCT System Development
8	KOREA Univ.	A-BNCT Linear Accelerator Engineering Design
9	KBSI	Eddy Current ECR Ion Source R&D

Contents

Summary

- Reflecting high demands from the communities, KOREA actively pursue to expand the scientific research infrastructures including superconducting fusion reactors, rocket launcher and various accelerator-based facilities. These facilities always require complex, high precision and state-of-the-art technologies with specialties.
- The primary mission of the ITER Korean Project (one partner of the ITER international Research Infrastructure) is to provide cutting edge fusion science and technology in a way to develop the commercial fusion reactor in the future.
- Nevertheless, the funder (KO Government) always demands social and economic added values from the Project. To meet these demands timely on the ITER KO Project, appropriate indicators that are useful and suitable for the socio-economic impact assessment should be further developed.
- However, for last 20 years many synergistic interactions between industries and large scientific facilities projects have been observed. From the industry point of view, more opportunities to participate in the large science facility projects to improve their technical capacities and capabilities as well as to acquire an opportunity to develop core technologies which have potential to be applied to the commercial products in near future.

Thank you for your attention.