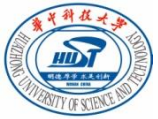

華中科技大學

University-Enterprise Collaboration at HUST

李培根

华中科技大学

2016年7月

Contents

- **Support organization**
- **Considerations**
- **Case studies**

依托单位/ Support Organization

华中科技大学 / 机械科学与工程学院
Huazhong University of Science and Technology /School of Mechanical Science and Engineering
材料科学与工程学院/School of material Science & Technology

依托单位/ Support Organization

机械科学与工程学院/School of Mechanical Science and Engineering

●机械工程学科评估全国第一（2012年）

Mechanical Engineering major was ranked No. 1 in China Discipline Ranking in 2012.

●数字制造装备与技术国重实验室:优秀（2013年）

The State Key Laboratory of Digital Manufacturing Equipment and Technology (DMET) was rated

"Outstanding" in China's SKL's evaluation in 2013

依托单位/ Support Organization

机械科学与工程学院/School of Mechanical Science and Engineering

- 制造装备数字化国家工程研究中心:优秀（2015年）/The State Engineering Research Center of Digital Manufacturing and Equipment: rated “Outstanding” in 2015
- 6位院士，20多位长江学者、杰青、千人计划专家/Six academicians, more than twenty scholars including “the One-thousand Talents”, “Yangtse Scholar”,and “National Science Fund for Distinguished Scholars”.

Contents

- Support organization
- **Considerations**
- Case studies

Considerations

产学合作的几点考虑/Considerations(1):

- 周济：服务乃宗旨，贡献即发展/Zhou ji: To serve is our goal; To contribute is our own development.
- 开放、责任意识/ opening and responsibility
- 通过社会服务在社会上留下深深的痕迹/Impacting greatly on the society through social service
- 引领本学科相关的技术和产业进步/To lead and guide technological and industrial development in respective fields

Considerations

产学合作的几点考虑/Considerations(2):

- 来自企业的课题一样可能是高质量的（即使从学术角度言）/Projects from Industry could be of high quality(even from the academic point of view).
- 引领区域科技发展/To lead and guide regional scientific and technological development.
- 授人以鱼，不如授人以渔/To teach a man how to fish rather than give him a fish.

Considerations

几点考虑/Considerations:

- 把国家级科技创新平台（国家重点实验室、工程中心）延伸到地方（为区域经济做贡献）/Extending the national science and technology innovative platforms (national key laboratories, engineering research centers) to the local areas (contributing to the development of regional economies)
- 为企业系统地、长远地、持续地去做一些工作/Providing systematic, long-term and sustainable service for enterprises
- 从学校层面组织、整合多学科力量/Promoting the integration of multi-disciplinary forces at the university level

Considerations

产学合作的几点考虑/thoughts on Industry-University Cooperation(4):

- 把企业不太擅长的课题做好/To pursuit projects that industry people may not be good at
- 促进科技成果转化/To promote the industrialization of scientific and technological achievements.
- 从工业界获取更多资源/To Get more resources from industry
- 有利于教育改革/To contribute towards education（knowledge transition, education reform, innovation ）

Contents

- Support organization
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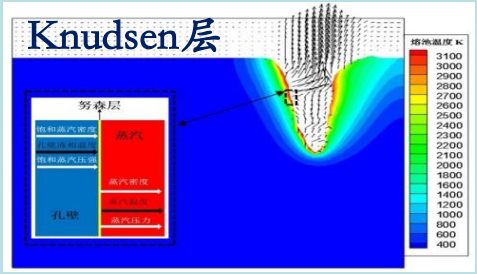
- **Case studies**

Case Studies——把企业不太擅长的课题做好

- 大功率激光焊接、切割机理复杂，装备是多学科交叉的光机电一体化系统，项目开展机理、工艺、装备全方位创新研究

机理（材料与光学）

精确处理Knudsen层（几个分子自由行程）间断边界，精度高

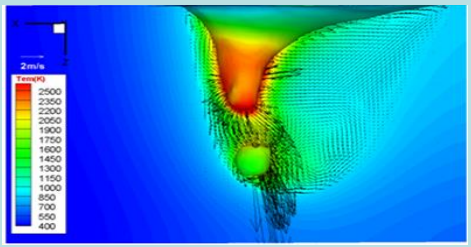


气-液锐利界面模型

$$\rho_l\left(\frac{\partial \vec{U}_l}{\partial t}+(\vec{U}_l\bullet\nabla)\vec{U}_l\right)=\nabla\bullet(\mu_l\nabla\vec{U}_l)-\nabla p_l$$

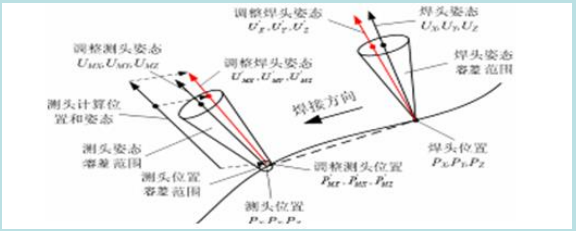
$$-\frac{\mu_l}{K}\vec{U}_l-\frac{C\rho_l}{\sqrt{K}}|\vec{U}_l|\vec{U}_l+\rho_l\vec{g}\beta(T-T_{ref})$$

缺陷仿真

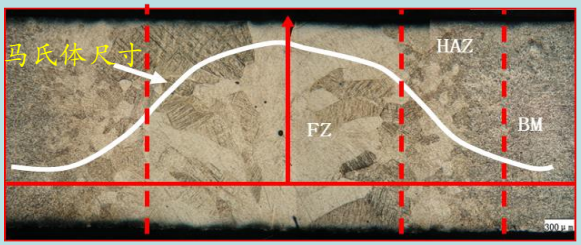


工艺（机械与控制）

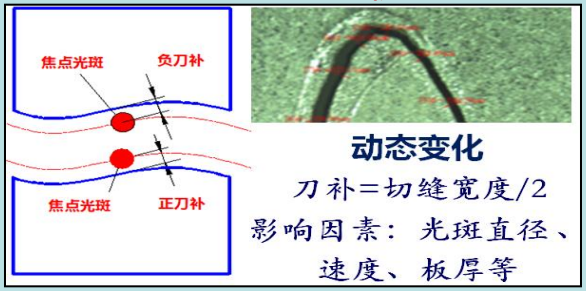
基于拼装状态的焊接位姿控制



组织成分控制实现焊接接头性能调控



曲线待焊板边激光切割轨迹正负刀补



动态变化

刀补=切缝宽度/2

影响因素：光斑直径、速度、板厚等

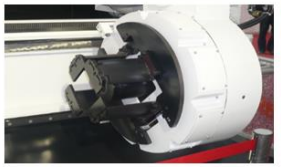
新型专用装置（集成）

形性控制

焊测补一体化装置

拼缝间隙校正装置

精确装夹

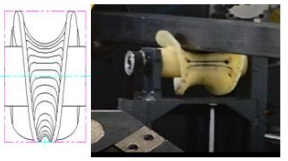


同步驱动头尾架

车身焊接夹具

自动化和生产柔性

自动上下料装置



多截面管材托架

Case Studies——把企业不太擅长的课题做好

❑ 项目历时十多年的产学研用联合攻关

华中科技大学

邵新宇教授为首，跨学科，主攻大功率激光加工机理、关键工艺、系统控制等

华工激光　法利莱

工艺验证、装备样机研发、工程化

需求驱动
学科交叉
产学研用
协同攻关

神龙汽车　江淮汽车　上海通用
江铃福特　长城汽车　中航精机
凌云工业

需求提出、协同开发、工业应用

Case Studies——把企业不太擅长的课题做好

- 项目获2015年国家科技进步一等奖

研发的典型装备：轿车白车身激光焊接生产线

上海通用武汉工厂车身车间唯一的国产线，产能：30万辆/年，生产线含五个工位：车身合装、顶盖点定、车身预定位、激光焊接、焊缝打磨

Case Studies——DGRI-HUST

广东华中科技大学工业技术研究院(DGRI-HUST)是由华中科技大学与东莞市人民政府于2007年合作共建（founded by HUST and DongGuan City in 2007)。

Case Studies——DGRI-HUST

研发与服务基地/(R&D and Service Base)

- 600多人研发团队
- 自主创办33家公司
- 国家技术转移示范机构(National example of technology transformation)

Case Studies——DGRI-HUST

青苹果：单元技术或原型样机

研发全自动RFID封装生产线原型机

红苹果：成套技术或完整产品

通过工程化开发，形成系列化RFID自动化封装装备产品

苹果树：系列产品并形成产业

形成系列化物联网产品，获得国家技术发明二等奖

Case Studies——DGRI-HUST

近距离：将国家级科研平台引入地方，近距离服务企业

建设六个国家平台分中心

零距离：派遣科技特派员长驻企业，进行端对端科技服务

派遣100多名科技特派员

负距离：建立集中式技术服务中心，企业上门寻求技术服务

建设五大技术服务中心，拥有600多项资质，服务7000多家企业。

Case Studies——DGRI-HUST

保姆：服务传统产业，做企业**想做做不好**的事情

全自动毛纺编织机

伙伴：共同发展新兴产业，做企业**想做不敢做**的事情

LED检测、分选装备

领航员：引领未来产业，做企业**没想到做**的事情

全自主无人艇

科技不仅要**支撑**产业，更要**引领**产业。

——李培根

Case Studies——DGRI-HUST

典型案例：

以广东3C产业为应用对象，建设智能制造车间，获批首批国家智能制造示范点

- 采用180台基于国产数控系统的高档数控机床
- 采用91台机器人，包括多关节机器人、AGV、RGV等

Case Studies——DGRI-HUST

❑ 推动产学研合作，促进科技成果转化

典型案例：RFID封装设备

国家863重大专项成果——工程化开发，原型机——产品，并实现了RFID从标签、读写器、应用系统到装备的系列化开发，学校成功获国家技术发明二等奖。

面向芯片后封装的高加速度运动系统的精确定位和操纵	国家基金重大项目课题
高性能数字制造装备中的物理场作用机理与精密操作	国家杰出青年基金项目
电子制造中的混合约束数字建模与产品缺陷诊断机理	国家973课题
高密度倒装键合中多物理量协同控制机制与实现	国家973课题
RFID标签封装设备开发与生产	国家863重大项目课题
封装设备关键部件与核心技术	国家IC装备重大专项课题
关键封装设备研制与生产应用	国家IC装备重大专项课题
RFID标签封装技术开发与装备产业化	省部产学研合作重大专项

RFID基础研究

系列RFID生产线

系列化物联网产品

Case Studies——DGRI-HUST

❑ 发掘产业重大需求，培育新型学科方向

典型案例：企业项目一样具有较高的研究水平和学术价值

企业委托线切割项目研发，开展分子动力学仿真与优化，获得国家自然科学基金支持

↓

开辟学校电火花加工研究新方向，为国家重大战略和区域经济发展服务

↓

研发精密线切割加工装备，在广东群达行、巨轮模具等一批模具企业成功应用

精密线切割机

Case Studies——DGRI-HUST

- 想着婆婆所需
- 不要忘了回娘家的路

——李培根

Case Studies——DGRI-HUST

❑ 营造人才培养环境，支持学生创新创业

- 建设大学生实习基地，接收学校学生进行生产实习
- **无偿赞助**举办大学生创新创业大赛，培养创新创业人才

大学生生产实习

“工研院杯”创新创业大赛

Case Studies——WRI

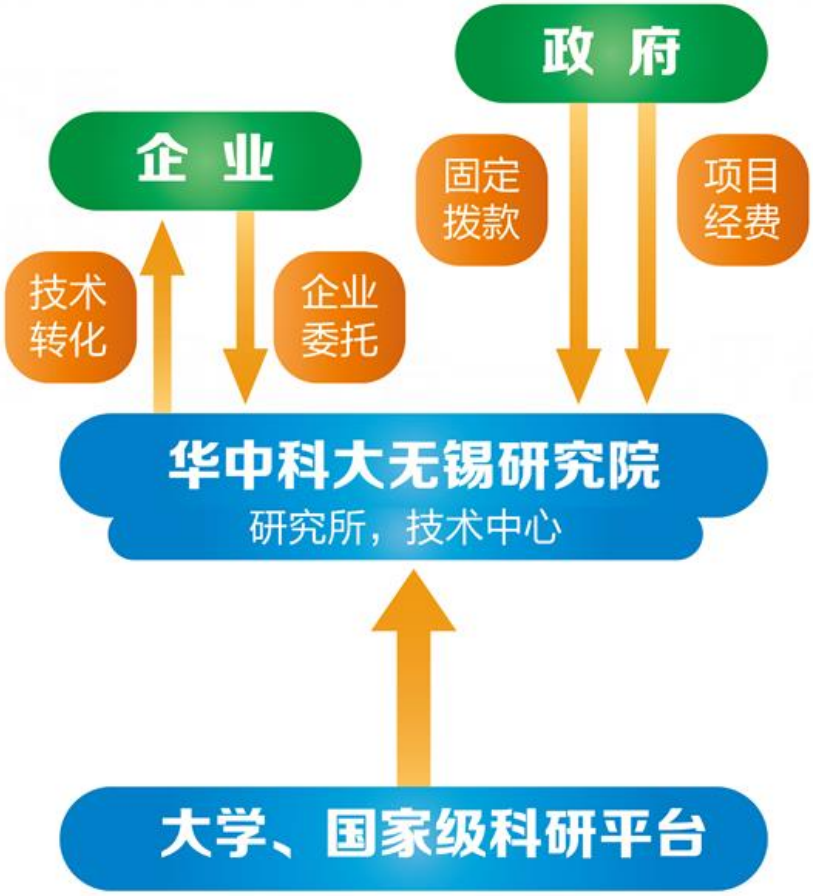
Wuxi Research Institute (WRI)

Research area

- High efficiency and high precision processing technology
- Technology for intelligent control equipment
- Technology for intelligent manufacturing automation system

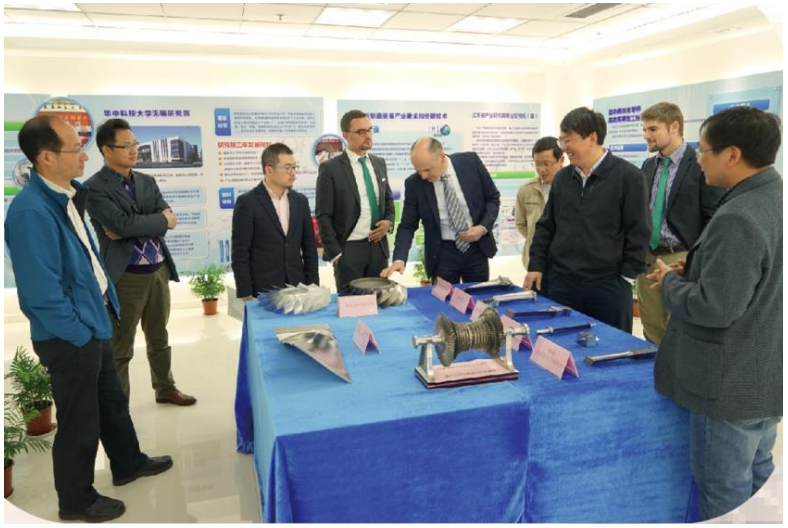
Case Studies——WRI

- Learning from the Fraunhofer-gesellschaft mode, the institute guide talents, technology and funding elaborately balanced and stimulate scientific achievements、products and service transforming to industry



Case Studies——WRI

International cooperation by working with experts from American, Germany and Japan in research and development, as well as personnel training.



Signatures on behalf of

State Key Laboratory of Digital Manufacturing Equipment and Technology
Huazhong University of Science and Technology，Wuxi Research Institute
date: 2015.6.12

Prof. Ding Han
Director DMET and HUST-WUXI

Dr. Zhang Gang
Project Manager DMET and HUST-WUXI

Signatures on behalf of

Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e. V
date: May 29th, 2015

Fraunhofer IFAM
Automatisierung und Produktionssystematik
Ottenbecker Damm 12

Prof. Dr. B. Mayer
Director Fraunhofer IFAM

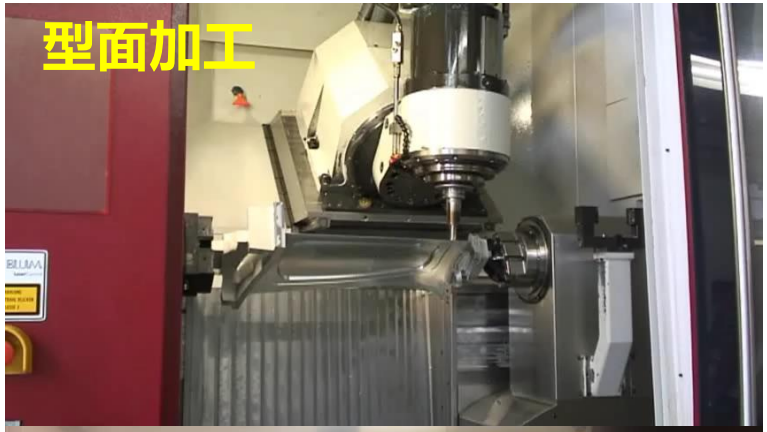
Simon Kothe
Group Manager Fraunhofer IFAM

Signatures on behalf of

The institute signed a cooperation agreement with Francis Fraunhofer Institute of Germany (IFAM) in May 2015.

Case Studies——WRI

Aero-engine Blades Machining Technology OGV (outlet guide vane) blade processing technology

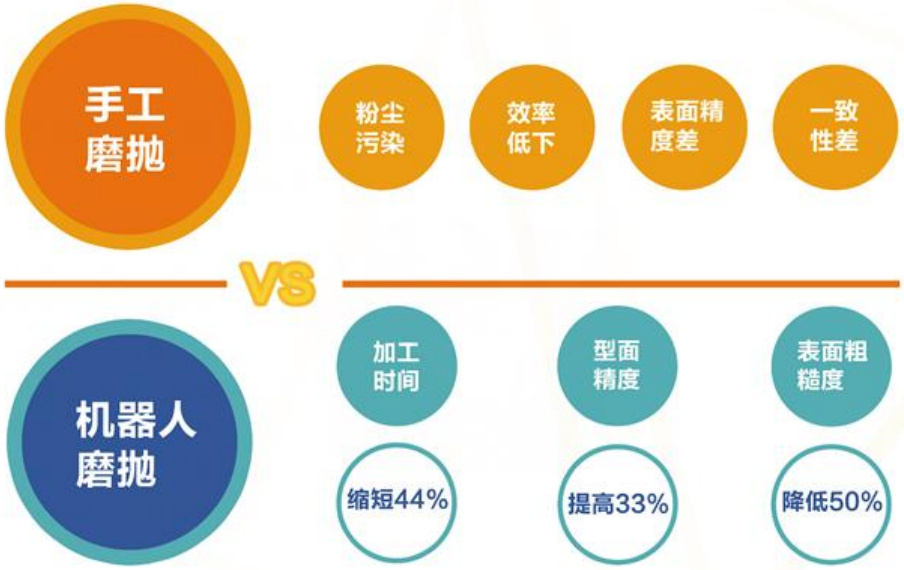


During the 3 months cooperation with WTB, the institute had successfully processed 7 OGV blades and had finished continuous process production of 5 OGV blades in the second batch production (over 200 dimensional parameters all meet requirement, for with WTB has not reach this level of standard after two years of development)

Case Studies——WRI

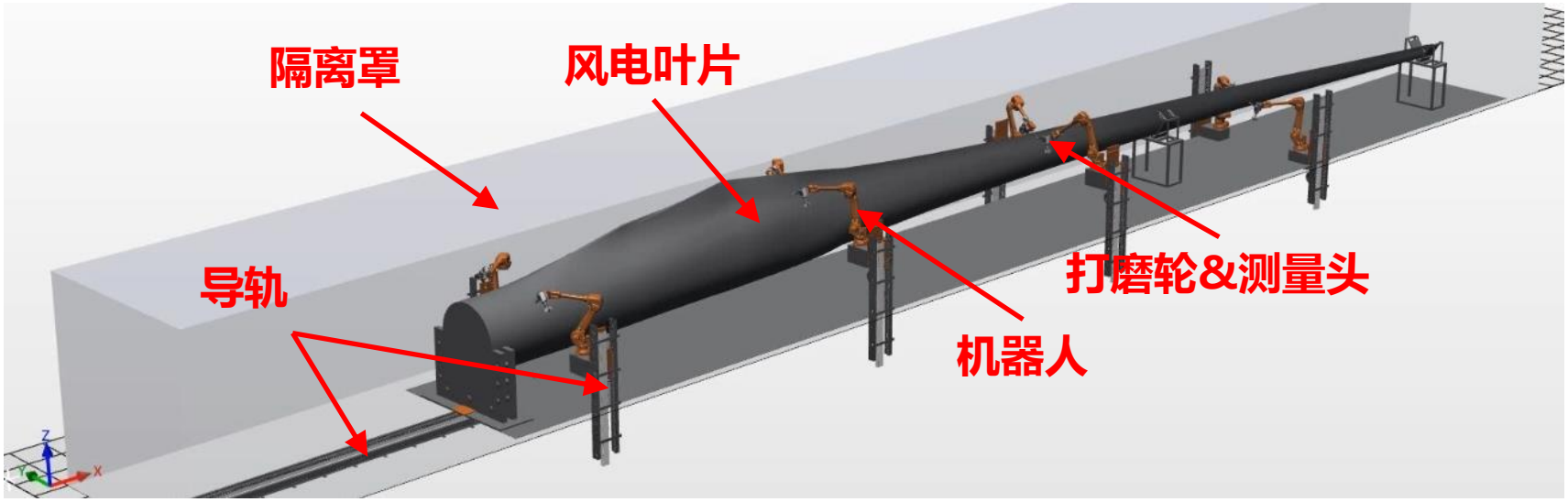
robotic grinding system for blades

laser scanning, error correction and on-line control ; automatic and flexible manufacturing of blade type complex surface ; gradually replace traditional grinding and polishing processes.



Case Studies——WRI

large robotic grinding system for wind turbine blades:low production efficiency, poor working conditions ,high cost of large wind power blade, ——multiple cooperative robotic grinding system for wind turbine blades（composite material ,over 40 meters long）



Case Studies——WRI

Guided by Industry 4.0 and Cyber-Physical System, the institute get through the barriers of production and operation control and build intellectual network in the production site by intelligent equipment and intellectualized reconstruction.

Case Studies——WRI

Invest in Incubation Platform

- Wuxi HUST Industry Incubator Ltd —— a subsidiary corporation of the institute which engaged in incubation of science and technology enterprises.
- has incubated 12 companies and the capital is 92 million yuan.

●无锡华科大智能装备科技有限公司	●无锡善利智能装备科技有限公司
●无锡华宇一目数字化检测技术有限公司	●无锡丹佛数控装备机械科技有限公司
●无锡华科汇能激光技术有限公司	●无锡特瑞菲克自动化科技有限公司
●无锡市华科力士水液压有限公司	●无锡市创世新科技有限公司
●无锡仰盛智能科技有限公司	●无锡指针创新科技有限公司
●无锡市华科顺达智能化技术研究院有限公司	●无锡睿途自控科技有限公司

华中科技大学-武汉钢铁集团联合实验室 (HUST-WISCO Joint Laboratory)

华中大-武钢联合实验室建立于2009年，面向武钢现实和未来发展需要的新技术、新工艺、新材料的研究开发以及全方位的技术合作、成果转化与人才培养。

The joint laboratory was founded in 2009, aims at new technology, new process, new materials, patent transformation and talent cultivation.

Case Studies——HUST-WISCO Joint Lab

核心任务（Key tasks）

- 项目研发 (Joint R&D)
- 成果转化 (Patent transformation)
- 人才培养 (Talent cultivation)

发展目标（Development goal）

- 校企合作典范
  (Model of university-enterprise cooperation)

奠基仪式 (Foundation ceremony)

揭牌仪式(Opening ceremony)

主要成果 (Main Achievements)

(1) 开展科研合作项目51项，合作经费 6000余万元，已结题验收32项，解决了一批武钢重大技术难题，产生年均直接经济效益3亿多元，推动了一批新兴产业的发展；

(2)联合申请专利42项、软件著作权5项、成果鉴定7项、发表高水平论文100余篇，联合申报国家及省部级课题多项；

(1) 51 cooperation research projects (32 finished), 60 million cooperation fund, average 300 million direct profit per year;

(2) 42 joint patent applications, 5 software copyrights, 7 achievement identifications, 100 high-level research papers, multiple national/provincial projects.

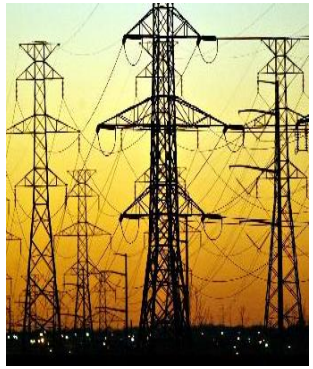
主要成果 (Main Achievements)

(3)为武钢培养各类优秀人才700余人；开展各类学术与技术、产业化合作交流会200余次；获批湖北省研究生工作站，获批全国示范性校企联合培养研究生实践基地。

(3) Trained 700 more talents, held 200 more forums, approved the graduate workstation by Hubei province and the national demonstrative university-enterprise joint training base for graduate students.

研发示例：武钢电网网损管理

（Power grid loss management for WISCO）



◆ 电网网损降损决策分析软件，确保电网安全运行

(electric system diagnostic software to reduce power grid loss for WISCO)

◆有效控制电网网损：在武钢用电总量增加的情况下，网损率一直控制在1.10%以下，与2005-2008年的平均1.725%相比，降低了0.6个百分点。三年间减少电费支出1.2亿元。

(the electric loss in WISCO has been well controlled. The rate of grid loss is now below 1.10%, much lower than before 1,725%. Saved 120 million RMB over the last 3 years.)

研发示例：回用水利用

（to utilize waste industry water, reduce consumption of new water,）

- 降低新水消耗，减少排污 (Provide technical support to utilize waste industry water, reduce consumption of new water, decrease pollution.)

- 废水回用总量由1500 m^3/h提高到了12800 m^3/h，年节约新水消耗近1亿吨 (Confirmed by field test and water quality analysis, the total amount of reused water increased from 1500 to 12800 m^3/h, saving 100 million tons new water per year)

Case Studies——HUST-WISCO Joint Lab

人才培养与培训 (Talent cultivation and training)

- 校企联合培养卓越工程硕士/ HUST-Wisco joint-supervision on outstanding masters of engineering
- 华中科技大学-武钢研究院研究生工作站/ HUST-Wisco graduate workstation
- 武钢青年英才培训 /Wisco young talents training
- 武钢首席师培训 Wisco chief technicians training

谢 谢！