High value-added products research for large engines and their technology maturity

SMDERI

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Catalog

- Reporter introduction
- High-value added products research for large engines
- What’s new on our latest research process
- Maturity of high-value added products' research
- Opinions & discussion

Reporter introduction

MAIN FIELD

1.Mechanical design;

2.Electro-magnetic design.

A

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Birth: Jan.19th 1987

B

Sep. 2012
Graduated as graduate student
from Pusan National University, South Korea
Major: Mechanical system design
2012 to present
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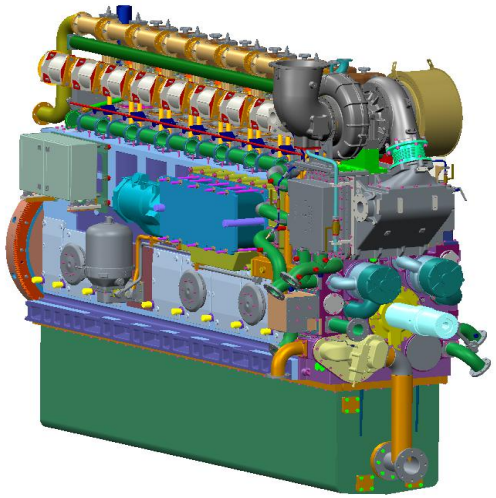
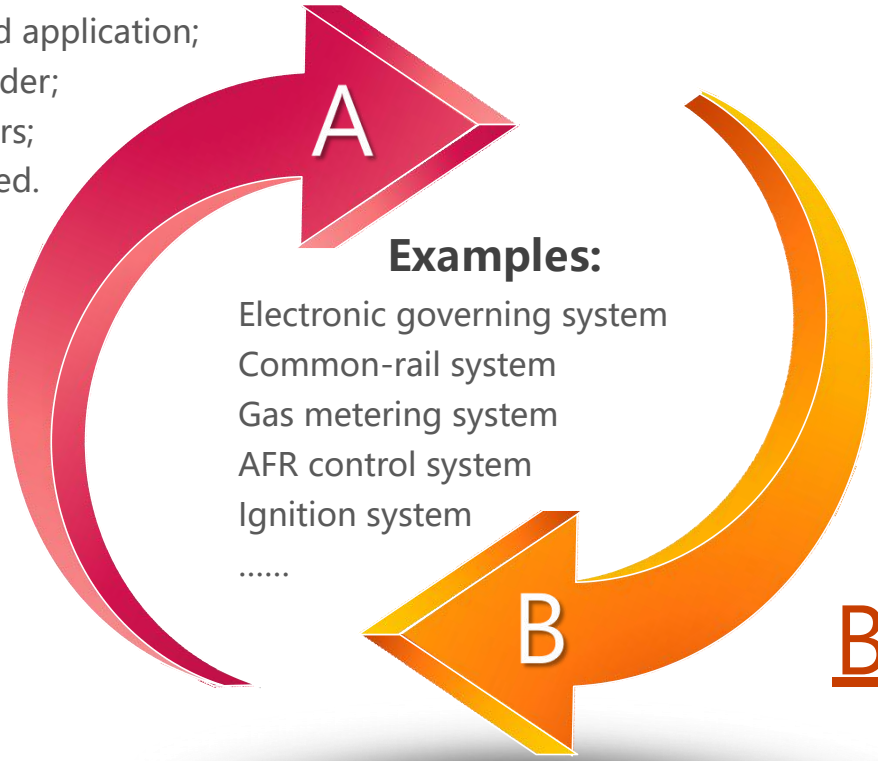
High-value added products research

A Large engine

- Marine or off-road application;
- 100-250kW /cylinder;
- With 8-20 cylinders;
- Diesel or gas fueled.





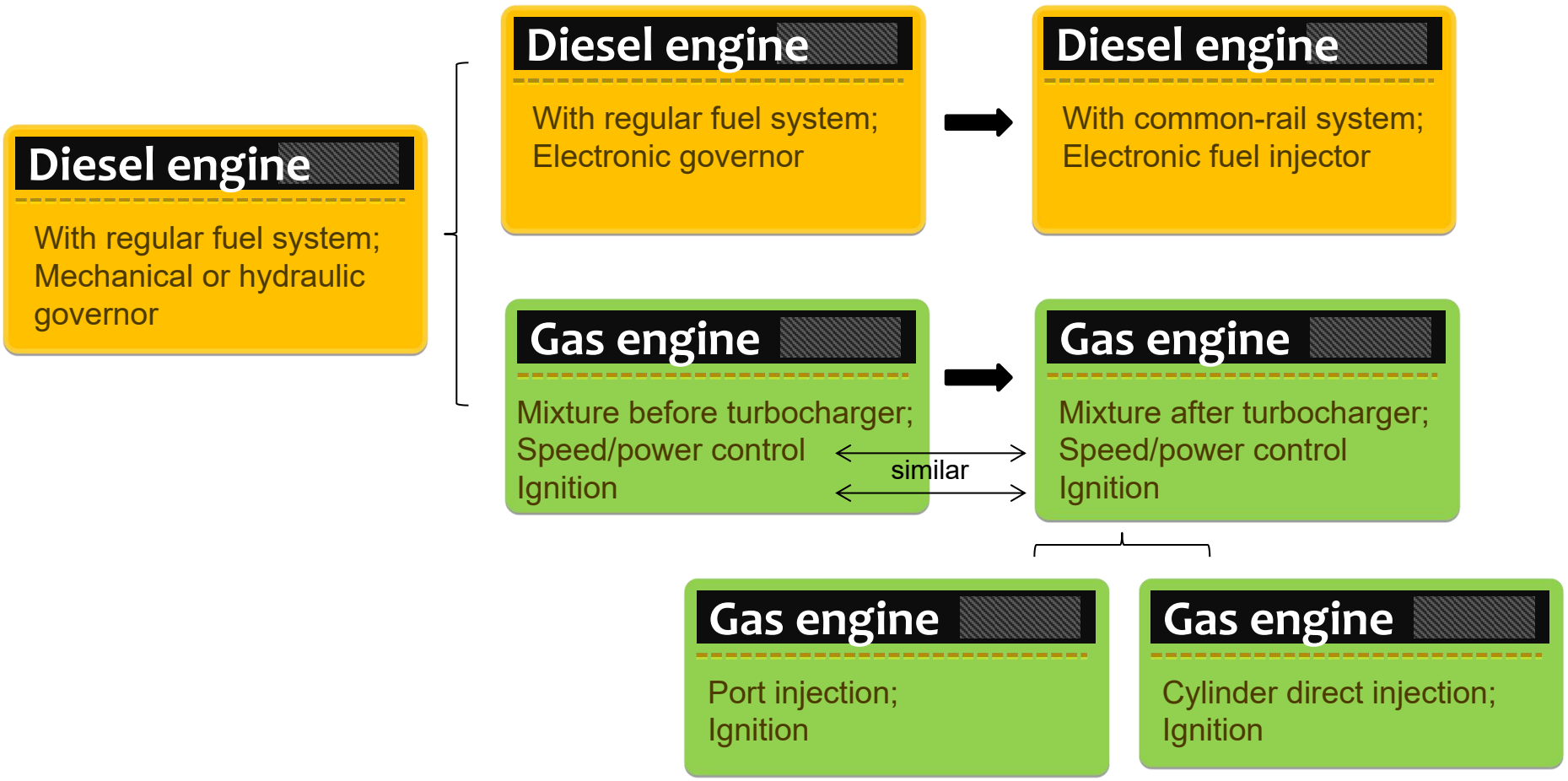
Examples:

Electronic governing system
Common-rail system
Gas metering system
AFR control system
Ignition system
……

B High-value added products

With vital function on engine Electromechanical system devices;
With high human cost on research;
Software customization available.

The key research contents



The key research contents

Diesel engine

With regular fuel system;
Mechanical or hydraulic governor

Diesel engine

With regular fuel system;
Electronic governor

→

Diesel engine

With common-rail system;
Electronic fuel injector

Gas engine

Mixture before turbocharger;
Speed/power control
Ignition

→

Gas engine

Mixture after turbocharger;
Speed/power control
Ignition

Gas engine

Port injection;
Ignition

Gas engine

Cylinder direct injection;
Ignition

The key research contents

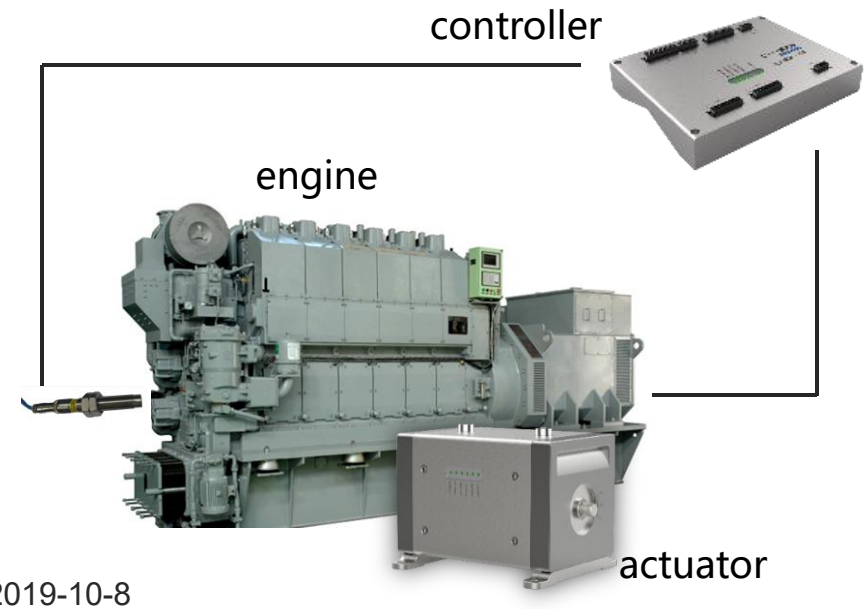
Diesel engine

With regular fuel system;
Electronic governor

➡

Diesel engine

With common-rail system;
Electronic fuel injector



The key research contents

The key research contents:

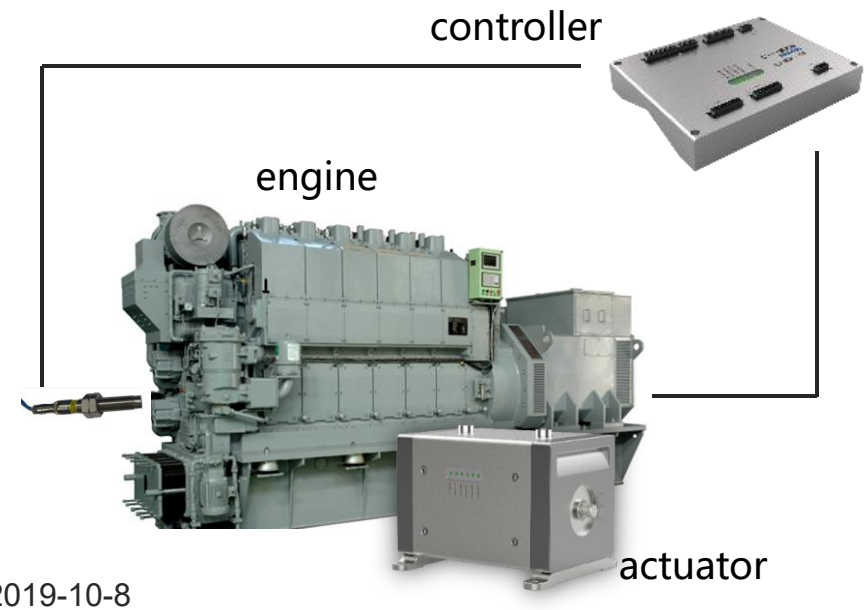
1.Control strategy;
2.Proper actuator selection (Mechanical/Hydraulic/Electrical);
3.Monitoring and alarming definition;
4.Local-calibration technology.

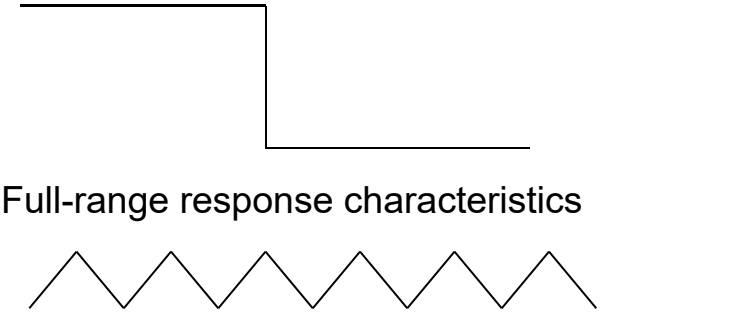
Diesel engine

With regular fuel system;
Electronic governor

Diesel engine

With common-rail system;
Electronic fuel injector





The key research contents

Diesel engine

With regular fuel system;
Electronic governor

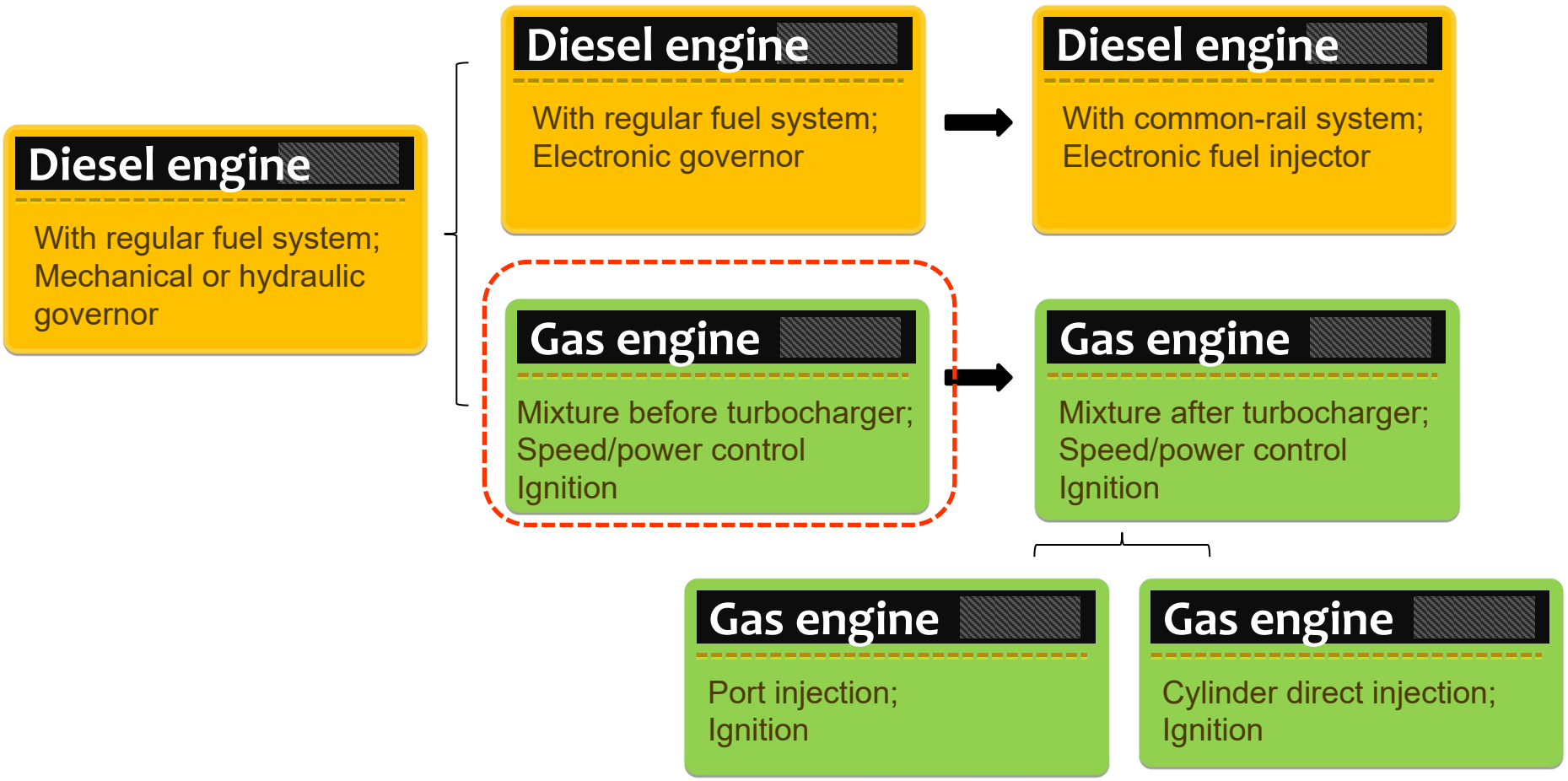
Diesel engine

With common-rail system;
Electronic fuel injector

The key research contents:

1.System design;
2.Pump/injector design;
3.Validated simulation technology;
4.Control strategy;
5.Monitoring and alarming definition;
6.Local-calibration technology.

The key research contents

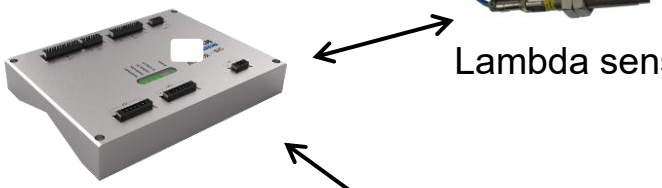


The key research contents

Gas engine

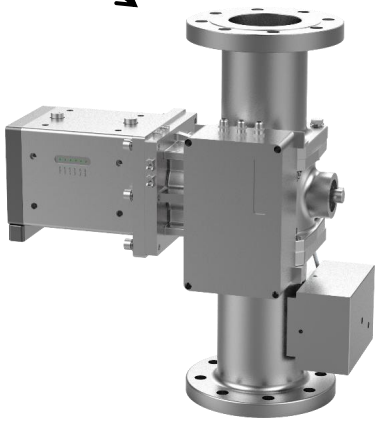
Mixture before turbocharger;
Speed/power control
Ignition

Lambda control



Lambda sensor

Controller



Gas metering and control

The key research contents:

1.Gas metering technology;
2.Lambda control technology (Close-loop/Open-loop);
3.Monitoring and alarming definition;
4.Local-calibration technology.

The key research contents

Gas engine

Mixture before turbocharger;
Speed/power control
Ignition

Turbo charger

↓ Mixed gas/air

Electrical valve

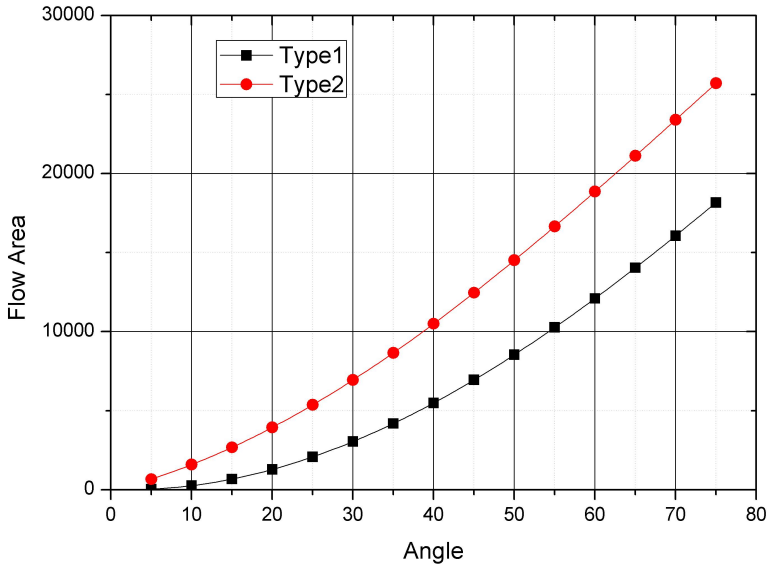
↓

Each cylinder

The key research contents:

1.Control strategy;
2.Proper actuator and valve selection;
3.Monitoring and alarming definition;
4.Local-calibration technology.

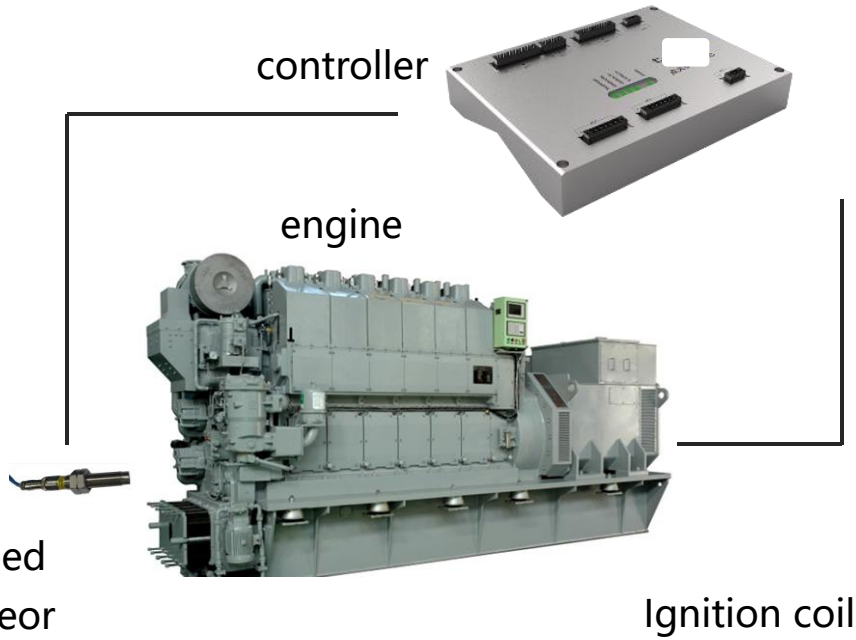
Comparison of flow area with different valve plate



The key research contents

Gas engine

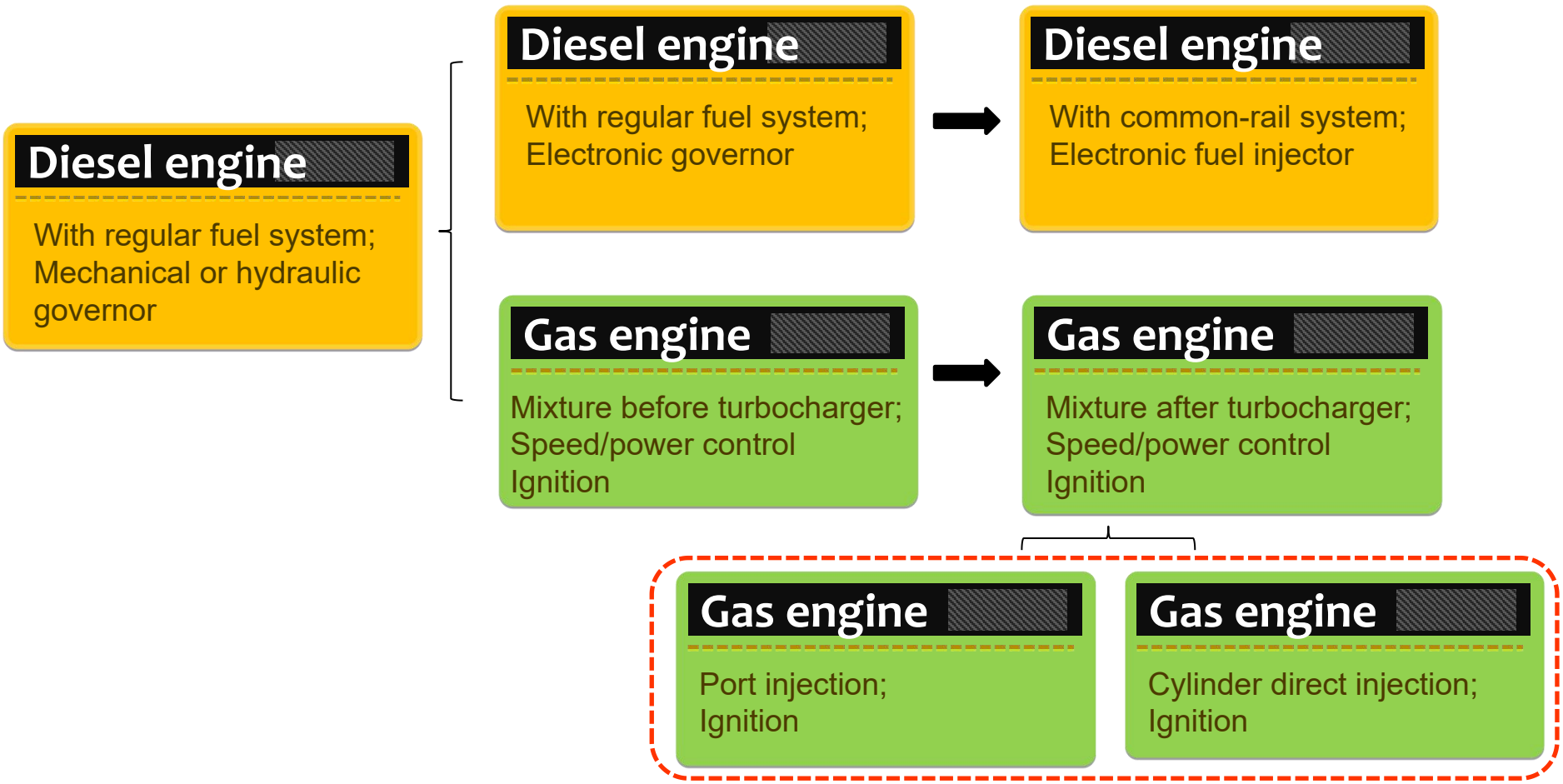
Mixture before turbocharger;
Speed/power control
Ignition



The key research contents:

1.Ignition energy control technology;
2.Timing control technology;
3.Coil design technology;
4.Monitoring and alarming definition;
5.Local-calibration technology.

The key research contents



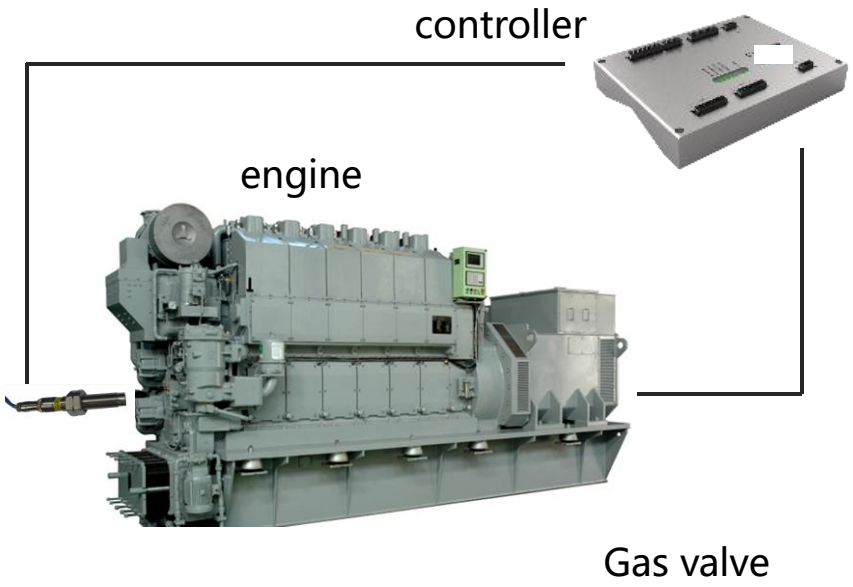
The key research contents

Gas engine

Port injection;
Ignition

Gas engine

Cylinder direct injection;
Ignition



The key research contents:

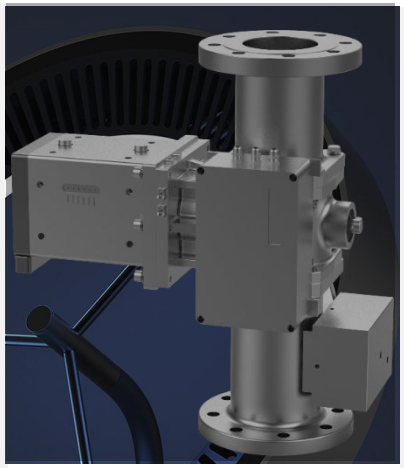
1.Gas valve design technology
(Sealing design/Electro-magnetic design);
2.Timing control technology;
3.Monitoring and alarming definition;
4.Local-calibration technology.

The key research contents

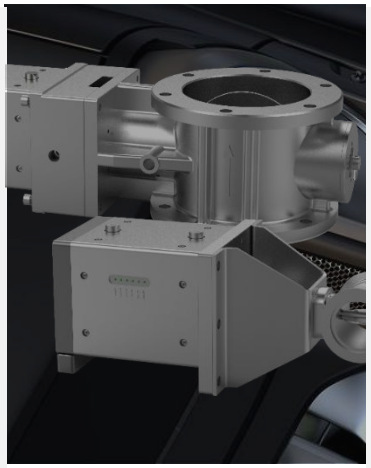
Conclusion:

Various controllers

Governing tech. (Diesel engine)



Lambda/Gas meter tech.



Speed/power control tech.(Gas engine)

Ignition system

What's new on our latest research process

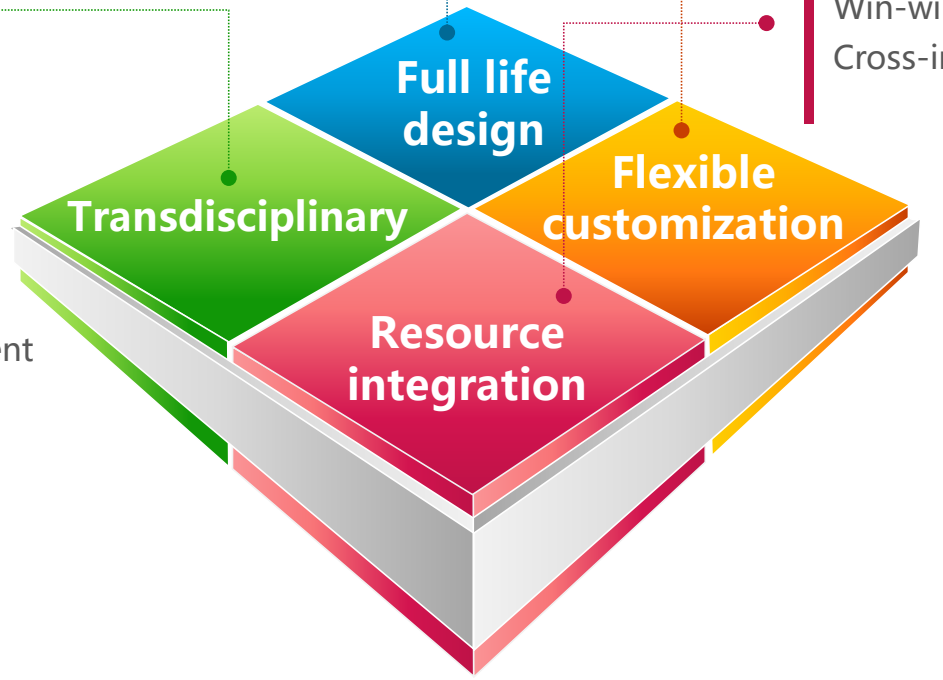
- FMEA application;
- HALT experiment;
- Application analysis;
- Update design library

- Correct design requirement definition;
- Flexible function interfaces;
- "Unit "and "System "organization;
- Feedback & Update

- Software/Hardware;
- Electrical Mechanical/ Magnetic
- Hydraulic/Pneumatic

- Technology
- System engineering;
- Project management
- Human resource management

Cooperation establishment;
Win-win mode;
Cross-industry research cooperation.



What's new on our latest research process

Transdisciplinary

•Gas metering valve: a integrated valve used to control and calculate the gas quantity passing through it.

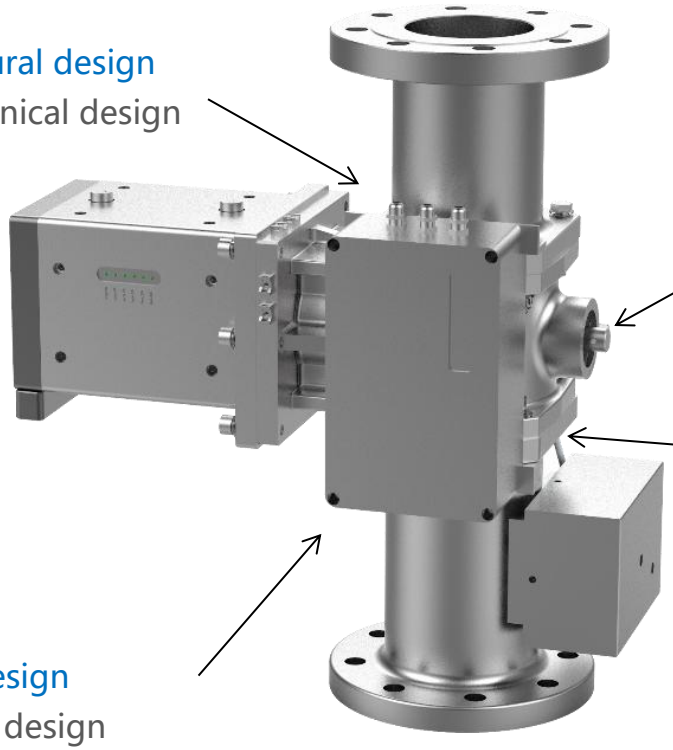
Structural design
Mechanical design

Gas valve design
Fluid dynamics

Driver design
Electro-magnetic

Control strategy
System design/coding

PCB design
Circuit design



GAS METERING VALVE

What's new on our latest research process

- FMEA application;
- HALT experiment;
- Application analysis;
- Update design library

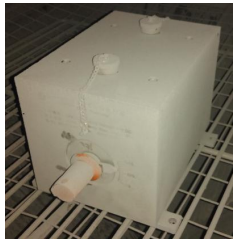
Full life design

A FMEA Application

- Predict the possible failures;
- Depend on experience;
- Collective intelligence.

B HALT & application analysis

- Verify the predictions by simulated environment;
- Connect common product to specific application.

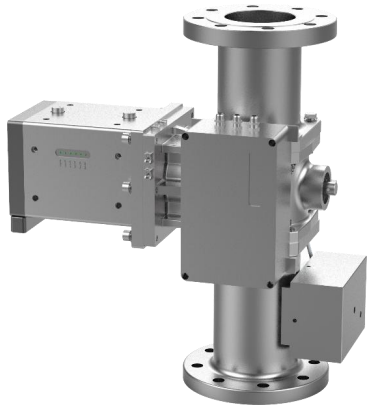


C Service & record

Let developer do it at first;
Documentation.

Input

A FMEA Application



What's new on our latest research process

- Correct design requirement definition;
- Flexible function interfaces;
- "Unit" and "System " organization;
- Feedback & Update

Flexible customization

Design requirement	Investigation of "future"; Investigation of "ourselves";
Function interfaces	Universality; Consider product family definition;
Unit and system	From system demands to unit functions; Units serve system; Modular design concept.

What's new on our latest research process

Cooperation establishment;
Win-win mode;
Cross-industry research cooperation.

Resource integration

Cooperation establishment

One's disadvantages and others' advantages(Required);
A clear view of long-term arrangement.

Win-win mode

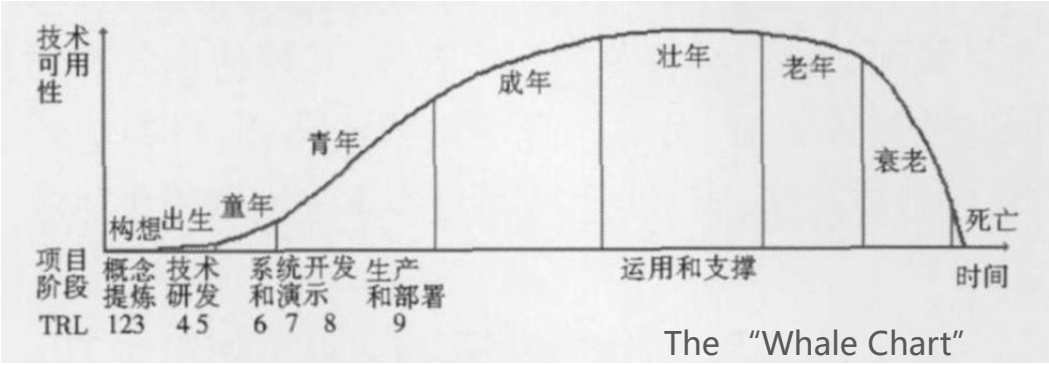
Cooperator win, we win;
Extended cooperation by frequent communication.

Cross-industry cooperation

Broader view of other fields to solve difficulties;
Broader view of solving difficulties for our fields.

Maturity of high-value added products' research

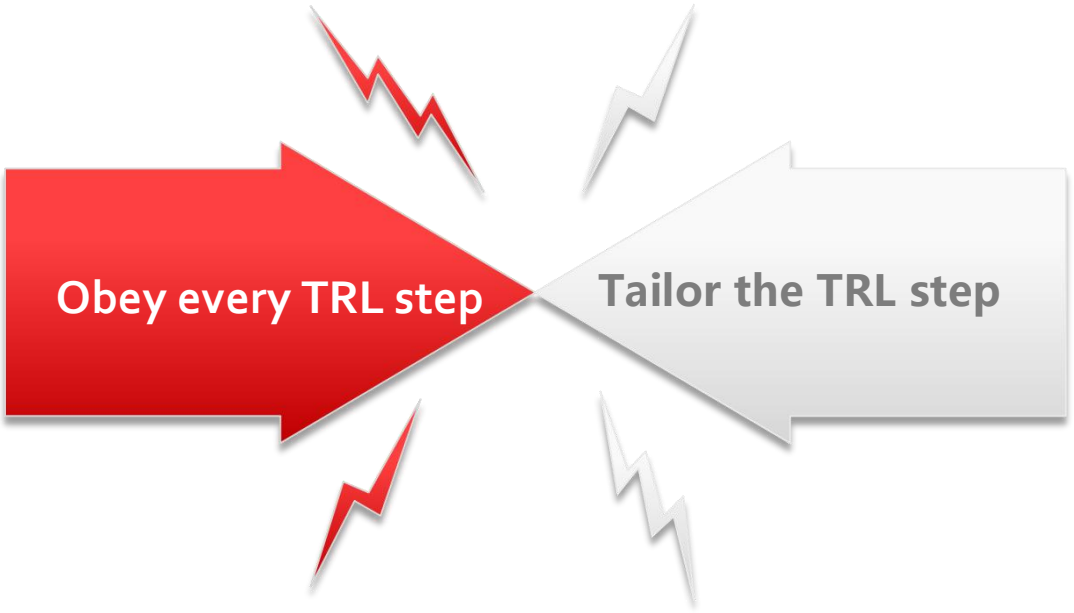
Technology Readiness Level		
TRZ1	Principle research	Concept; illustration; conception develop; basic concept; key performance; concept usability; function proven
TRZ2		
TRZ3		
TRZ4	Prototype validation	prototype validation; laboratory validation; component; laboratory condition;
TRZ5		
TRZ6	System demonstration	technology / prototype / system / sub - system demonstration; integrated systems;
TRZ7		
TRZ8	Production evaluation	mission; qualify; certification; proven; manufacturing;
TRZ9		



The "Whale Chart"

Maturity of high-value added products' research

Obey or tailor



Maturity of high-value added products' research

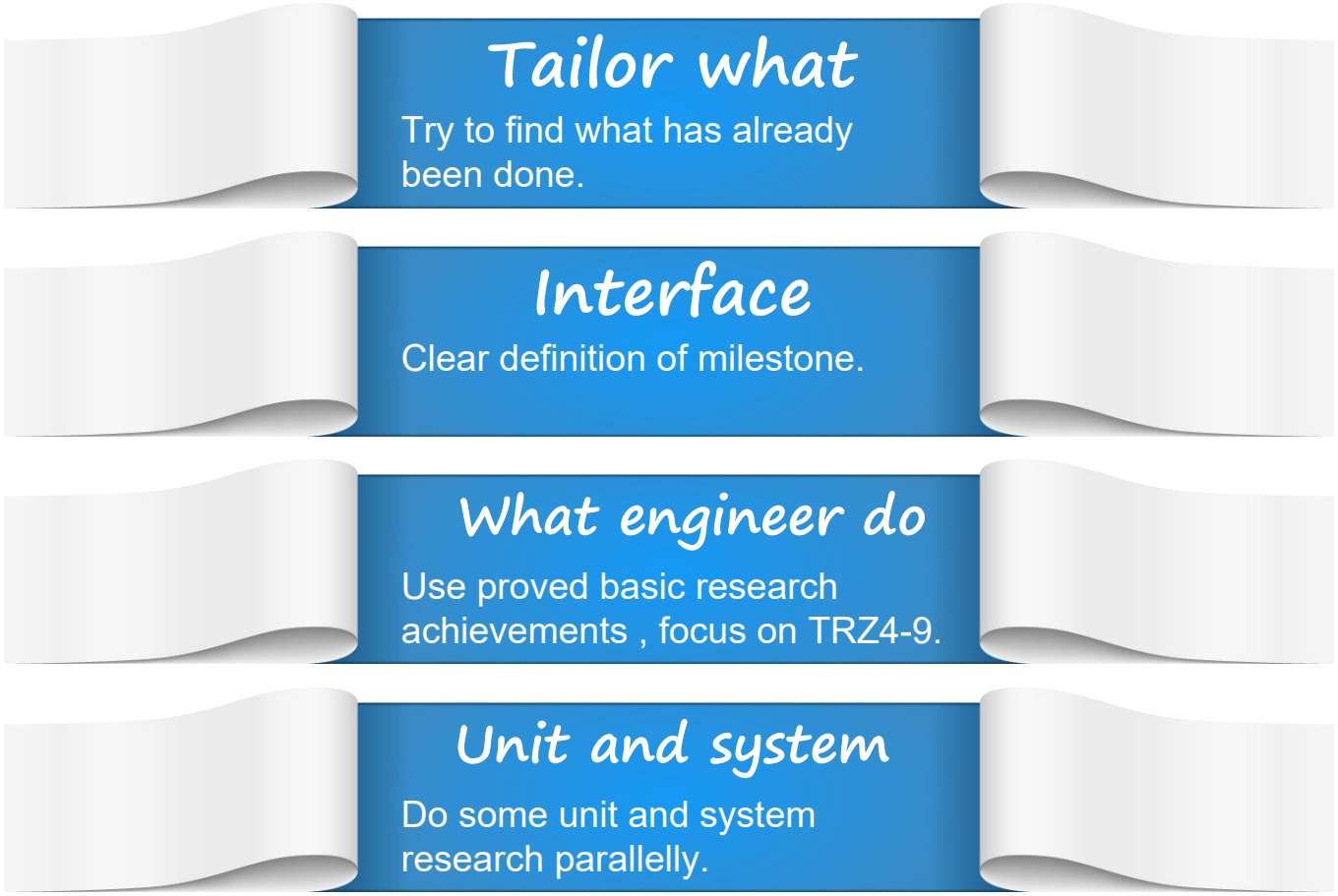
Obey or tailor

Maturity of high-value added products' research

Obey or tailor

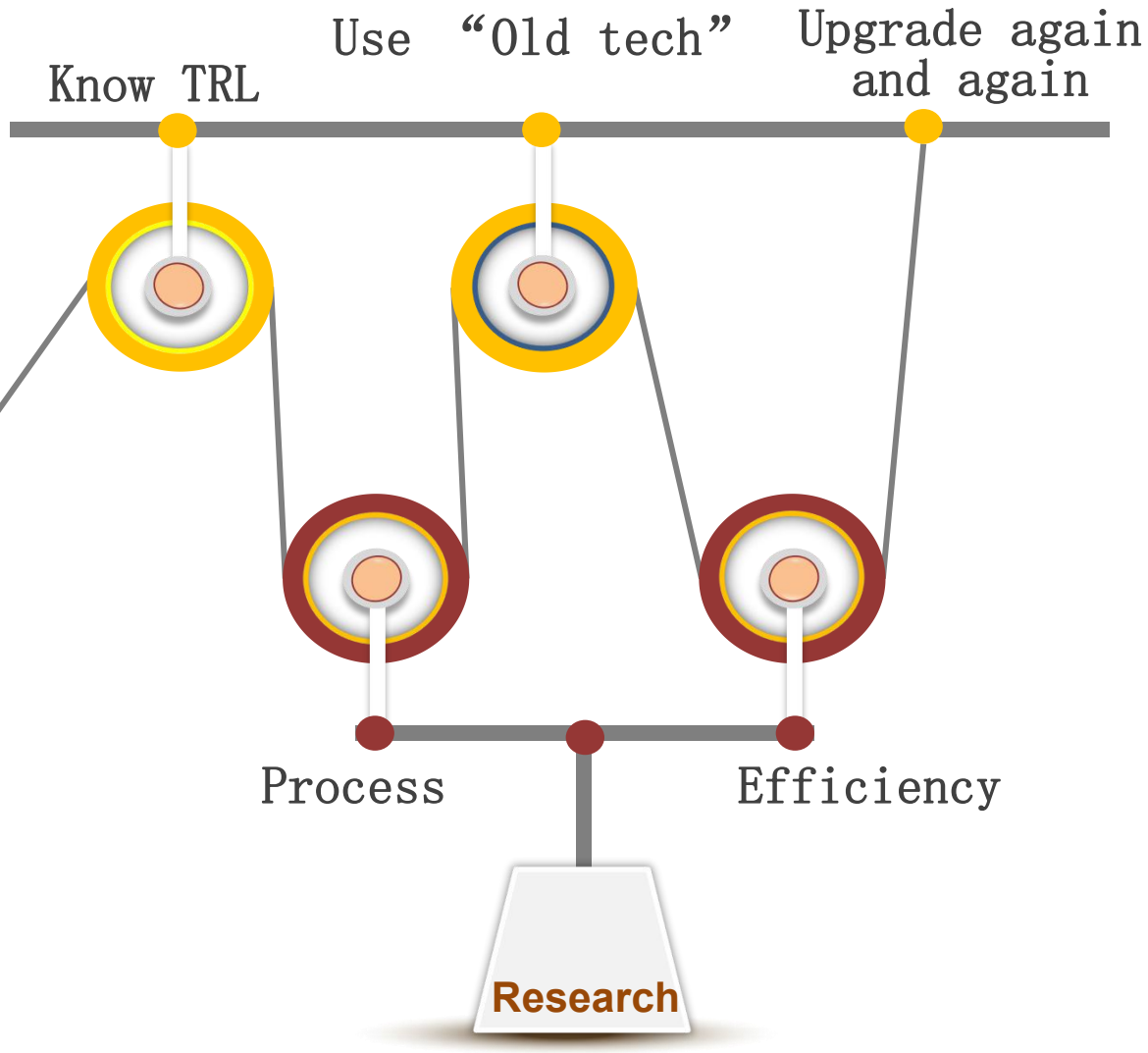
Maturity of high-value added products' research

Obey or tailor



Maturity of high-value added products' research

Conclusion



Tailor your process

1. Controlled risk;
2. Familiar application;
3. Urge you to find an cooperator.

Opinions & discussion

High-value added products' research for large engines.

Transdisciplinary
Full life design
Flexible customization
Resource integration

Recycled old technology
Upgrade
Why to tailor a TRL process

Opinions & discussion

Developing opinion

- As a young engineer, my view of new products' research keeps developing.
- Resonance from audiance.

Ideas to share

- Like Tai Ji, we are trying to find balance between many things.
- Fine-grained division will change the research method significantly.
- Win-win mode will be key for future.

Thank you for your time!