Dimensional Control Survey Proposal

Ver. Date : 2017.06.15

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Our Business

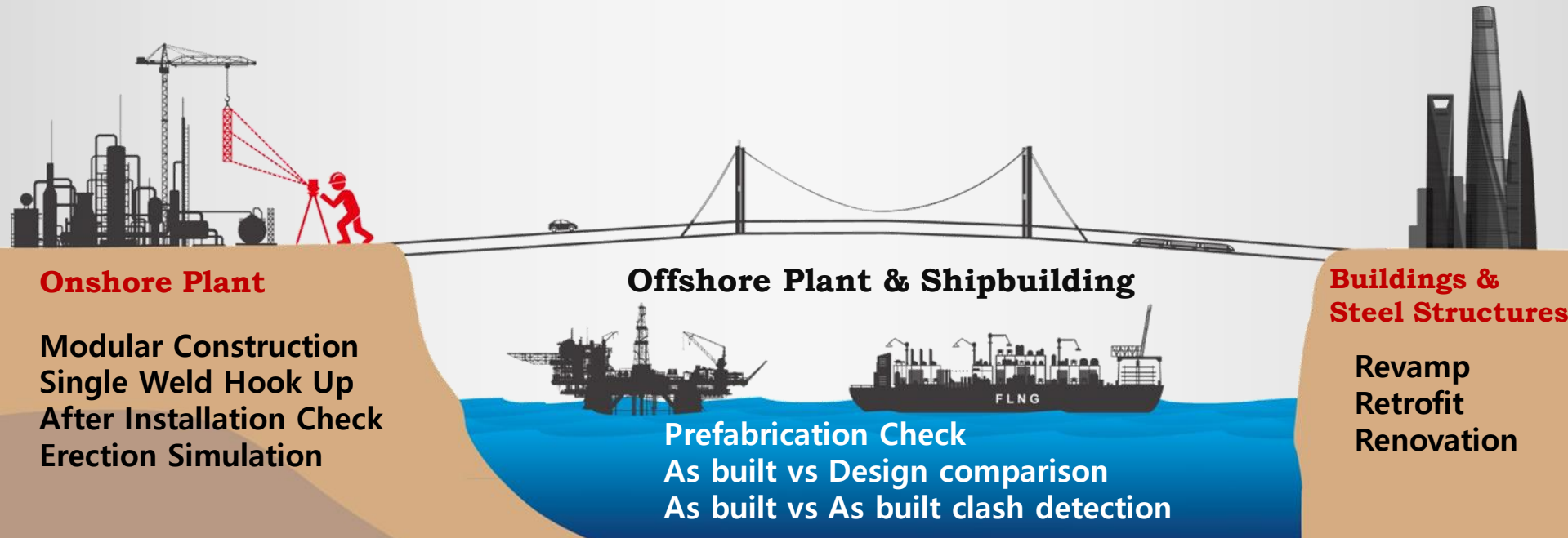## World's #1 Dimensional Accuracy Control Technology

Accurate
- +/- 1mm (1/24") Accuracy
- 0 failures in First Time Fit

Fast
- 50% faster than other leading technologies

Know How
- 10 years of consulting in Dimensional Control and Dimensional Control ONLY!

Onshore Plant

Modular Construction
Single Weld Hook Up
After Installation Check
Erection Simulation

Offshore Plant & Shipbuilding

Prefabrication Check
As built vs Design comparison
As built vs As built clash detection

Buildings & Steel Structures

Revamp
Retrofit
Renovation

Why is Dimensional Control so important?

Small accuracy errors accumulated during pre-fabrication lead to huge problems during installation

Re-work on module installation stage increases danger of industrial accidents, and cause decline of work efficiency
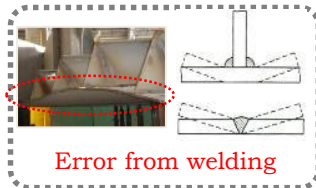

Error from cutting

Processing Error

Deformation
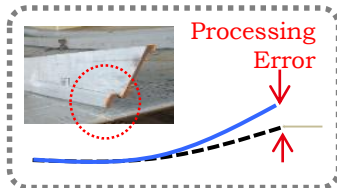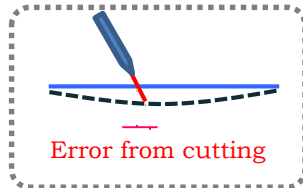
Cutting → Sub - Assembly → Assembly → Transport → Installation
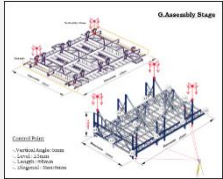
Error from welding

Mis-alignment

>> **Increases cost, duration, and safety hazard**

Objective of Dimensional Control : First Time Fit

Dimensional Accuracy Control in Modular Construction

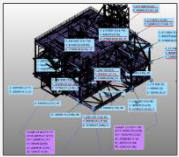## Most measurements are taken without stopping work process

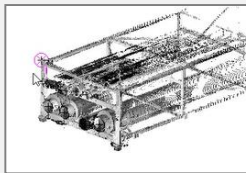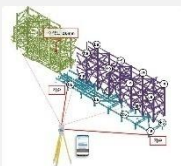| Construction Phase	What we offer	How Fast we do it
Pre-Fabrication	**Dimension Check** • Design vs build control to minimize errors in pre-fab	Measured while being built 1~3 Checks per module 2~3 hours per check
Assembled Work	***Clash Detection** • Pipe Spool clash check using as built vs as built clash check simulation before transportation	Measured while being built 1 day : Pipe Rack (~80 spools) 1~3days : 4~500 Ton 1 week : 2,000 Ton+
After Transport	**Deformation Check** • Check for deformation after transport	Measured before installation 1~2 Hours
After Installation	**Installed Module Check** • Check proper installation of the module to prepare for next installation	Measured while positioning module 1~2 Hours

Dimensional Accuracy Control in Modular Construction

Pre-Fabrication : Minimize errors during assembly quickly

Average Error Occurrence : 16~37%

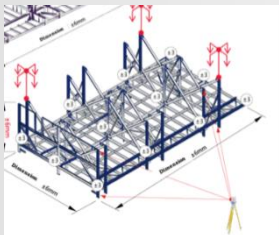Error from cutting

Error from welding

Assembly
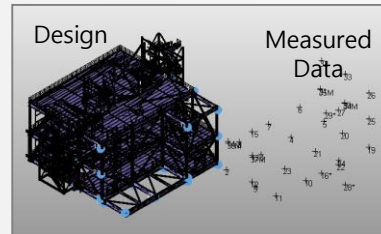Error
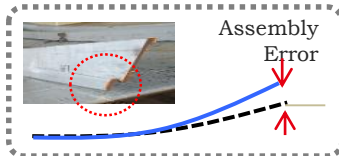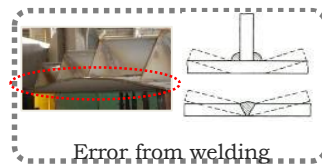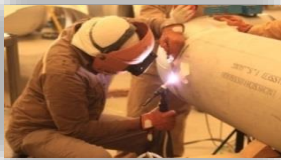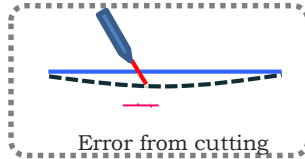
Solved by

1 ~ 3 Measurements per module

2~3 hours per measurement

Errors are caught and corrected without interruption

How we do it
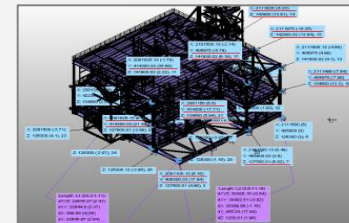
Measured while being built

Design   Measured Data

Simulation

Instant Comparison Report

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Dimensional Accuracy Control in Modular Construction

Detect & Fix errors before transporting the module

Around 70% mis-alignments occur during installation leading to increased safety hazard & cost
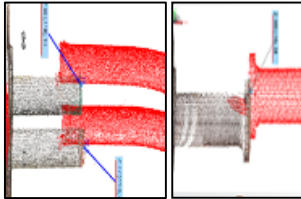
Misalignment

Onsite modification

»

1 measurement

1 day per measurement

Errors are caught and corrected without interruption

How we do it

Module A

Module B

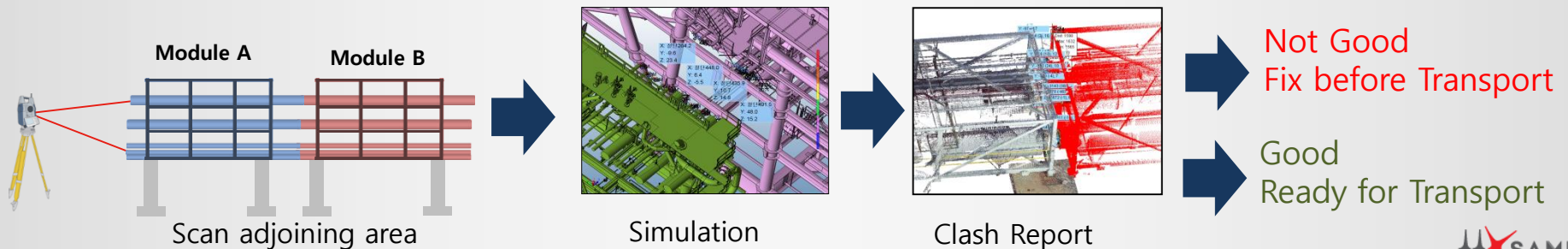Scan adjoining area

Simulation

Clash Report

Not Good
Fix before Transport

Good
Ready for Transport

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Dimensional Accuracy Control in Modular Construction

Deformation check after transport

20% of modules are deformed during transportation

Damages incurred from Lifting and Transporting
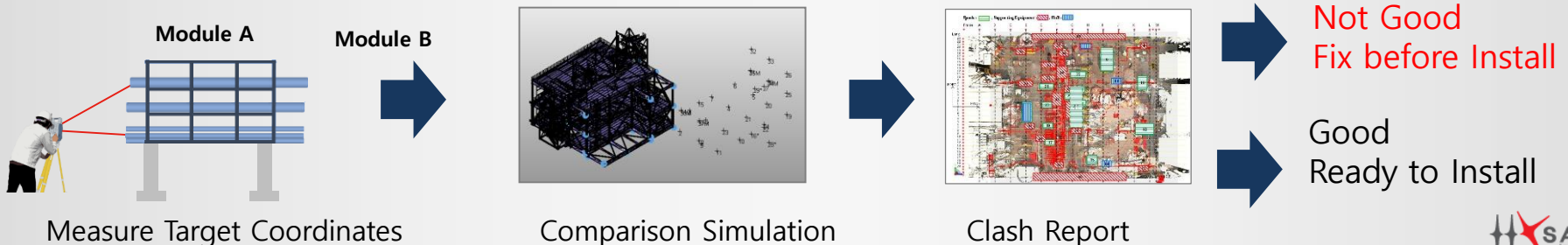
1 Measurement

1~2 hours per measurement

Stand by time : 2hrs

How we do it

Module A   Module B

Measure Target Coordinates

Comparison Simulation

Clash Report

Not Good
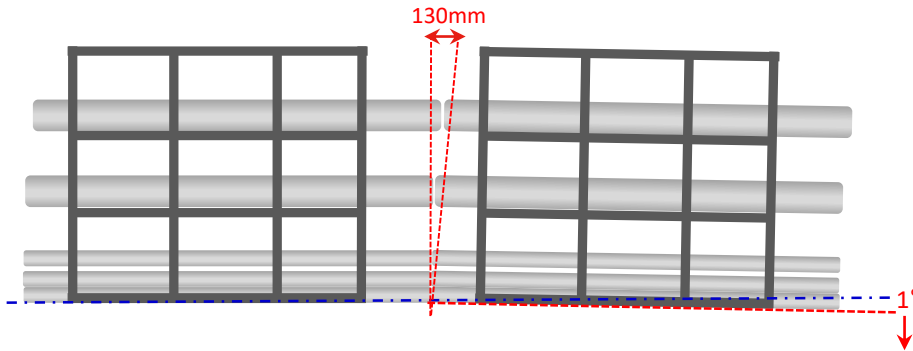Fix before Install

Good
Ready to Install

Dimensional Accuracy Control in Modular Construction

Installation Check

Without Dimensional Accuracy Control angle error, positioning error occurs 99% of time

130mm

1°

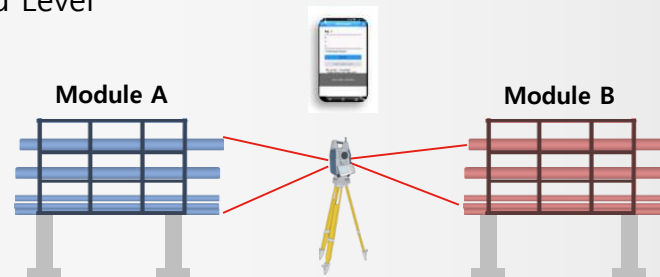Wrong Angle, Tilting to one side

»

1 Measurement

1~2 hours per measurement

Stand by time: 2 hrs

How we do it

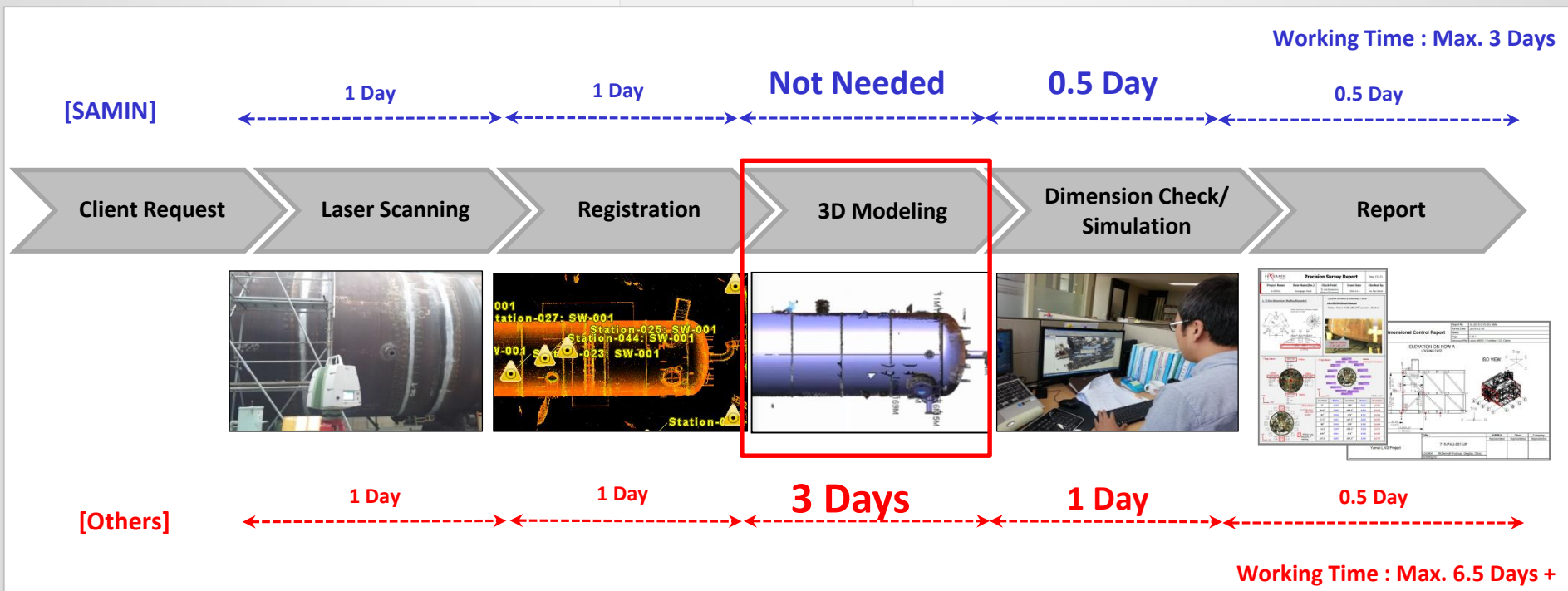Measure and check Angle, Vertical Position, and Level while setting the module

Module A

Module B

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Samin's Core Competency : Accuracy, Speed, Knowhow

10+ years of technological advancement in Dimensional Control

More than 50% Faster

Working Time : Max. 3 Days

[SAMIN]

| 1 Day | 1 Day | **Not Needed** | **0.5 Day** | 0.5 Day |

| Client Request | Laser Scanning | Registration | 3D Modeling | Dimension Check/ Simulation | Report |

[Others]

| 1 Day | 1 Day | **3 Days** | **1 Day** | 0.5 Day |

Working Time : Max. 6.5 Days +

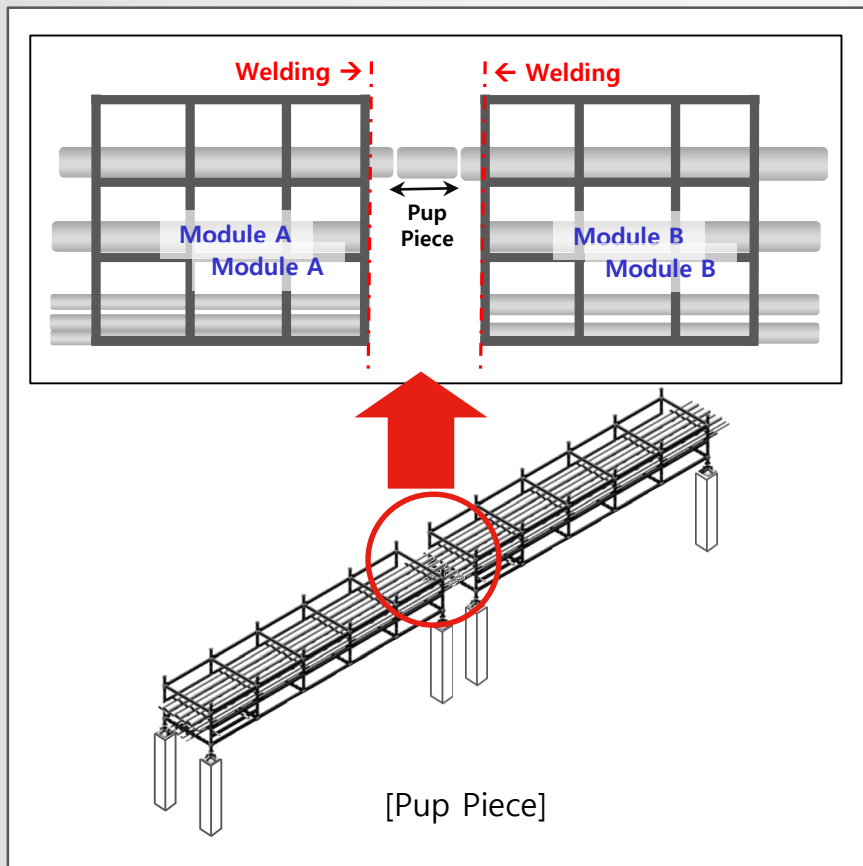**Single Weld Hook UP
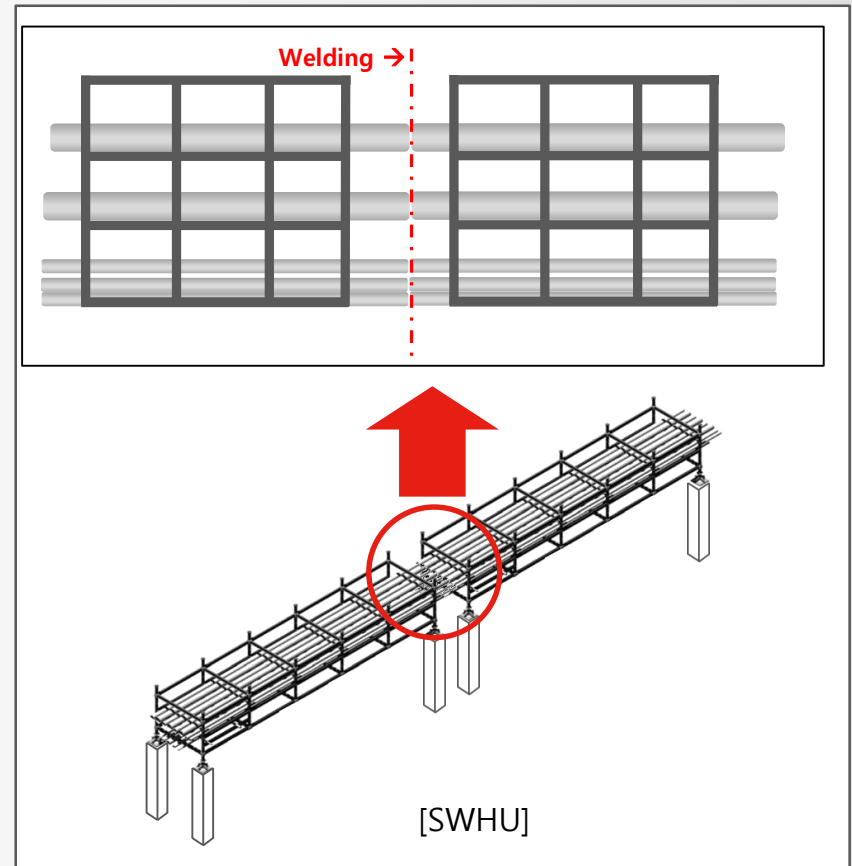Realistic View**

SWHU in Modular Construction

First Time Fit on site is achieved through Single Weld Hook Up (SWHU)

- SWHU : Conjoining pipes without using Pup piece and only welding in a single area
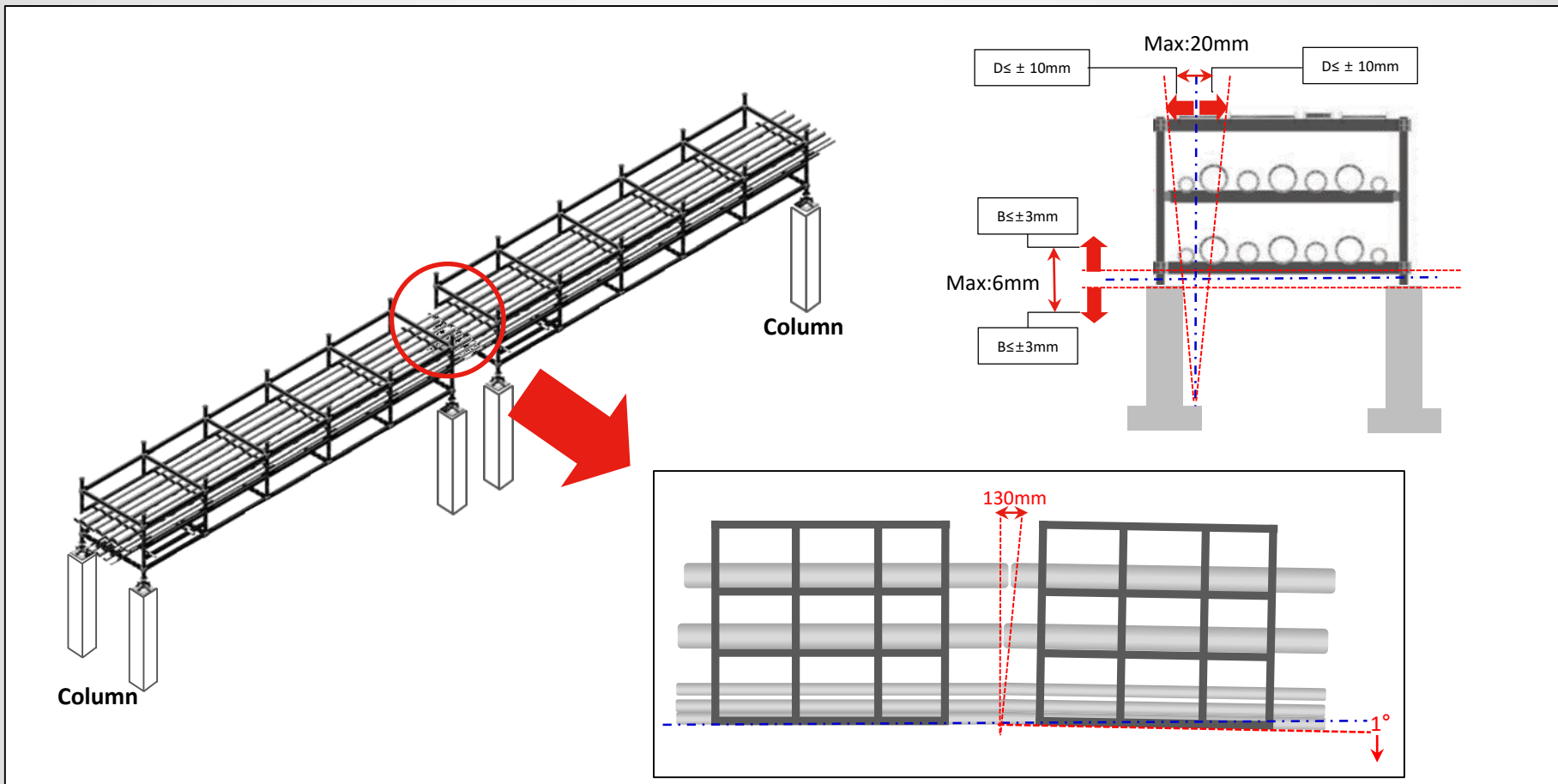
Without Dimensional Control

With Dimensional Control

Welding → ! ! ← Welding

Module A
Module A
Pup Piece
Module B
Module B

[Pup Piece]

Welding →

[SWHU]

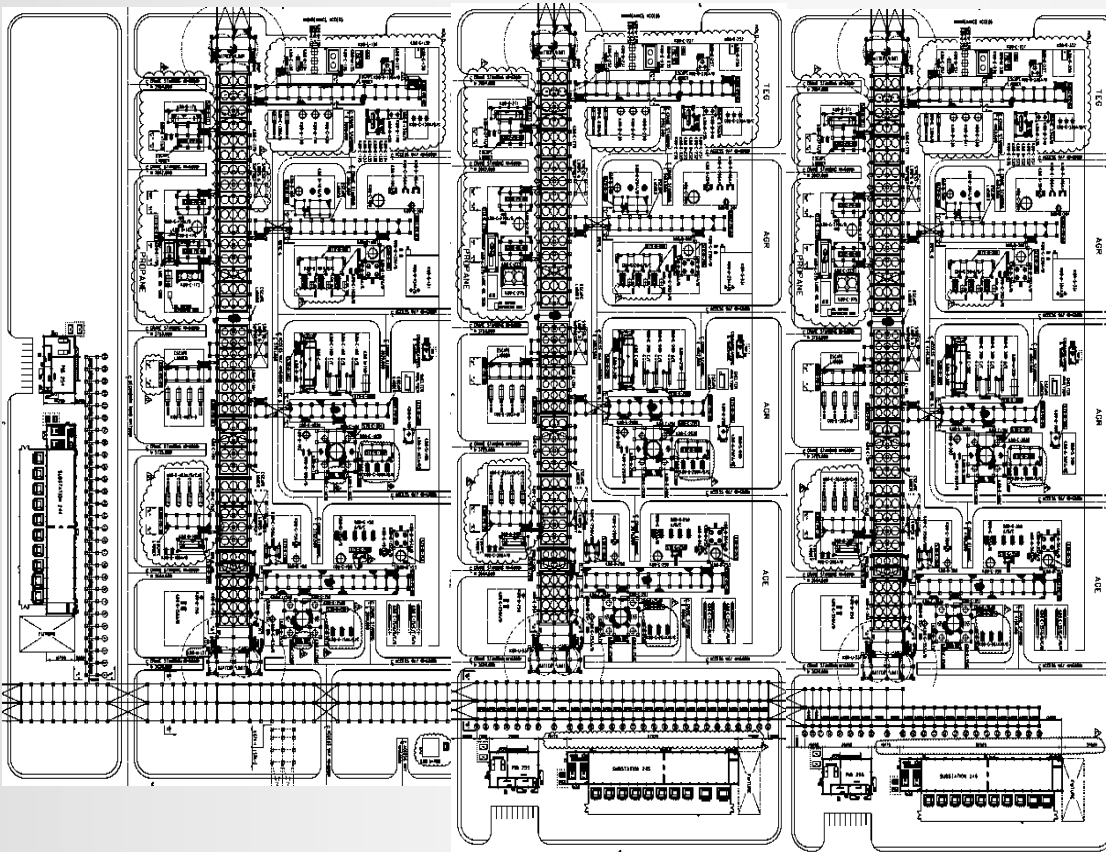# Reality in today's SWHU

Theoretically, SWHU should reduce cost and resources by 50% or more

Reality : Construction companies spend millions of dollars extra to implement SWHU do to lack of experience and right tools (No single company achieved 100% SWHU as of today)
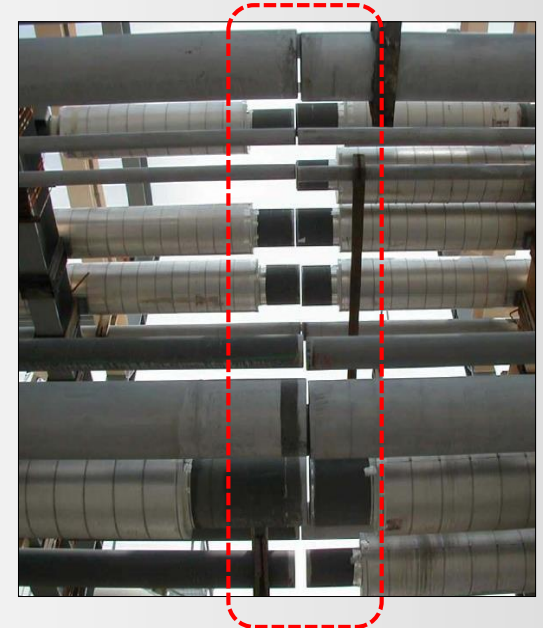
Reality in today's SWHU

What companies are doing :
Mix of Stick Built, 'Pup Piece', and SWHU (20~50%)

Creating 'Reserve' to make room for mis-alignment

SWHU in Samin Dimensional Control - Benefit

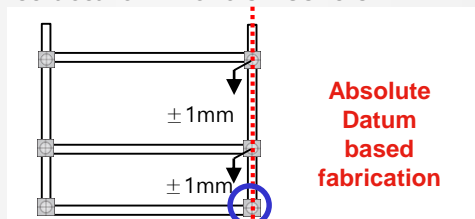## Case without Samin Dimensional Control

Company A spent $4million on design change and $4million+ more extra installing the modules

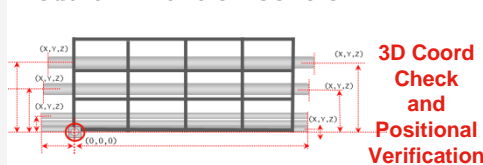| PKG	STEEL STRUCTURE		PIPING		TOTAL
	Pre-assemble	Modularized	Pre-assemble	Modularized	
PKG A	900 Ton 27 EA	5,800 Ton 61 EA	1,500 Ton	5,800 Ton	14,000 Ton
PKG B	4,000 Ton 34 EA	3,700 Ton 89 EA	2,300Ton	1,900 Ton	11,900 Ton
PKG C	400 Ton 4 EA	2,000 Ton 22 EA	-	1,600 Ton	4,000 Ton
TOTAL	5,300 Ton	11,500 Ton	3,800 Ton	9,300 Ton	29,900 Ton

With Samin Dimensional Control

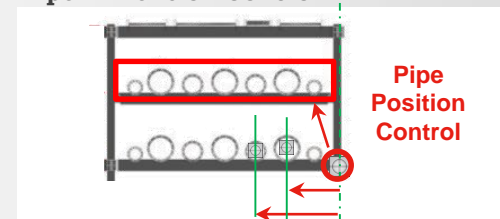Design change is minimized, and can apply SWHU on most installations (80%+) **at fraction of the cost**

Structure Dimension Control

±1mm

±1mm

Absolute Datum based fabrication

Pipe Dimension Control

Pipe Position Control

Module Dimension Control

(X,Y,Z)
(X,Y,Z)
(X,Y,Z)
(X,Y,Z)
(X,Y,Z)
(X,Y,Z)
(X,Y,Z)
(0,0,0)

3D Coord Check and Positional Verification

Simulation between modules

Installation Clash Detection Simulation

IN

References & Case Studies
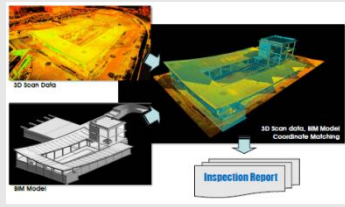
Project Reference

| Project	Year	Work Scope	RM
S-Oil RUC Project	2016~ 2017	• 3rd Party Dimensional Inspector of Project Owner • HS FCC Vessel Dimensional Inspection • HS FCC Vessel Installation Simulation & Inspection	• Scanner : Leica C10, P30 • Total Station : Leica MS 50 • Pre Process : Cyclone • Inspection & Simulation S/W : EcoPASS, EcoInspection(Specialized Dimensional Control s/w dev. by SAMIN)
LNG Plant Project	2015	• LNG Plant Module and Vessel Dimensional Error Analysis • Dimension Check for 600ton, 2000ton, Column • Module and Vessel Installation Simulation	• Scanner: Leica P20 • Data Process : Cyclone • Analysis & Simulation S/W : EcoPASS, EcoInspection(Specialized Dimensional Control s/w dev. by SAMIN)
CBDC Plant Project	2013	• Large Column (External/Internal) Dimensional Inspection • Flatness of Skid Base, Nozzle Orientation, Straightness, Roundness & Internal Tray Dimensional Accuracy Comparing 3D Design and 3D Laser Scanning Data	• Scanner : Leica P20 • Data Process : Cyclone • Inspection S/W : EcoInspection (Specialized Dimensional Control s/w dev. by SAMIN)
Gorgon LNG Plant Project	2012~ 2013	• Providing 3D Dimensional Control Solutions and Laser Scanner • Technical Training for Shop and Site Survey using Laser Scanner and Total Station • Technical Training for Dimensional Error Analysis using Software Solution	• Scanner: Z+F IMAGER 5010C • Total Station : SOKKIA NET • Inspection S/W : EcoInspecion, EcoBLOCK, EcoOTS(Specialized Dimensional Control s/w dev. by SAMIN)
Semi-Sub Project	2011~ 2012	• Technical Training for Preparing Dimensional Control Procedure & Field Application of 3D Dimensional Control Solution • Providing 3D Dimensional Control Solution	• Total Station : SOKKIA NET • Inspection S/W : EcoBLOCK (Specialized Dimensional Control S/W dev. by SAMIN)

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Project Reference

Project		Year	Work Scope	RM
Prelude FLNG Project		2014~ 2015	• Clash Check : Topside Module integration to hull • Project Range : 12 Modules + 1 Flare Tower • Report to Owner & Construction Company : Clash, Dimensional Error, Tight Gap	• Scanner : Leica C10 • Data Process : Cyclone • Clash Check S/W : EcoPASS (Specialized Dimensional Control S/W dev. by SAMIN)
Q-204 FPSO Project		2013	• Lower Turret Installation Simulation • Gap and Clash Check When Lower Turret is located to the certain critical elevation. (Hull : 3 Elevations/ Lower Turret : 3 Elevations) • Report to Owner & Construction Company	• Scanner: Z+F IMAGER 5010C • Data Process : Cyclone • Simulation S/W : EcoPASS (Specialized Dimensional Control S/W dev. by SAMIN)
Spar Hull Project		2016	• Spar Hull Dimensional Error Analysis and Erection Simulation • 50m Diameter sized Cylinder Structures Dimension Check and Structure Alignment Check	• Scanner : Leica P40 • Data Process : Cyclone • Inspection S/W : EcoPass (Specialized Dimensional Control S/W dev. by SAMIN)
Jackup Project		2013~ 2014	• Technical Training for Preparing Dimensional Control Procedure & Field Application of 3D Dimensional Control Solution • Providing 3D Dimensional Control Solution	• Total Station : SOKKIA NET • Inspection S/W : EcoBLOCK (Specialized Dimensional Control S/W dev. by SAMIN)
Shanghai Tower		2013~ 2014	• Utilizing 3D Dimensional control software for Shanghai landmark dimensional quality control	• Total Station : SOKKIA NET • Inspection S/W : EcoBLOCK (Specialized Dimensional Control s/w dev. by SAMIN)

Project Reference

| Project		Year	Work Scope	RM
SAMSUNG Display Factory Modeling		2016	• As-Built 3D Modeling Project • Factory Scale : 310×110×5m 7stories LED factory • 15 Years old factory ; Less factory drawing information. • Compare the existing drawing and present state • Verify the area need to be replaced and added.	• Scanner : Leica C10, P30 • Pre Process & Modeling : Cyclone
Heavy Structure Inspection (Huisman-Yard)		2016~ 2017	• Dimensional Inspection for mega sized crane equipment. (HEEREMA 10,000T Crane, Boskalis 3000T offshore platform truster etc.)	• Total Station • Inspection S/W : EcoMES, EcoBlock (Specialized Dimensional Control s/w dev. by SAMIN)
Building Inspection		2014	• Dimensional Inspection for irregular shaped building comparing Design and 3D Scanning Data • Dimension check for columns and roof • Providing Inspection Report.	• Scanner : Leica C10 • Data Process : Cyclone • Inspection S/W : EcoPASS (Specialized Dimensional Control S/W dev. by SAMIN)
Macau Hotel Tower		2014~ 2015	• Providing 3D Dimensional control inspection service for building module dimensional error analysis	• Total Station : SOKKIA NET • Inspection S/W : EcoBLOCK (Specialized Dimensional Control s/w dev. by SAMIN)
HuTong Bridge		2015~ 2016	• Utilizing 3D Dimensional control software for China railway bridge dimensional quality control	• Total Station : SOKKIA NET • Inspection S/W : EcoBLOCK (Specialized Dimensional Control s/w dev. by SAMIN)

Offshore Plant - FLNG

- Project Summary : The Word Largest Ship – FLNG Topside Module Clash Check Simulation

- Project Purpose :

- Spools, pipes, a lot of outfitting on module are temporarily placed, also there are a lot of scaffolding and cable support, so it is not easy to forecast the expected location of clash after the erection.
- Because of safety reason it is not allow anybody to enter and do any modification work in PE place.
- All modification works should be done in fabrication location after the modules is brought back if any clash happens.
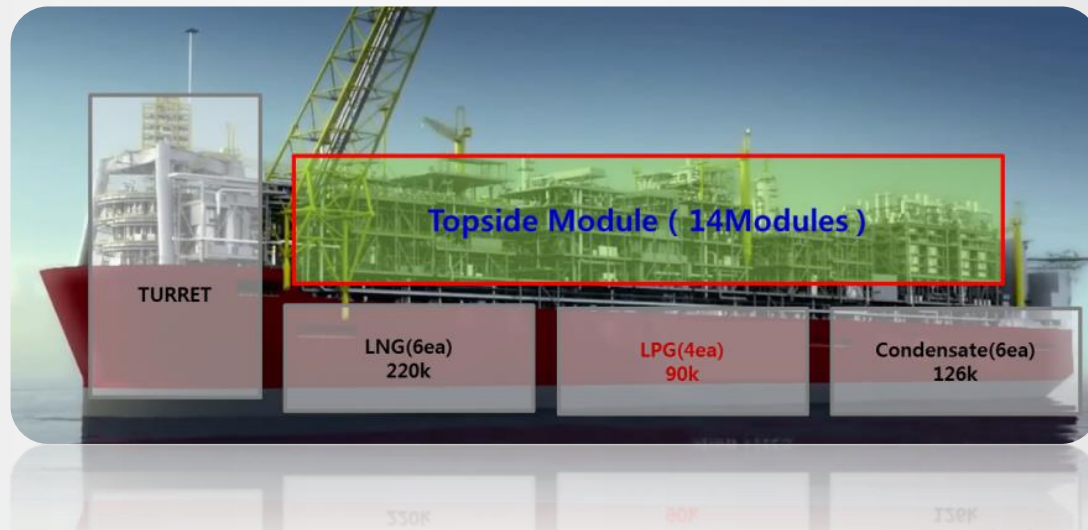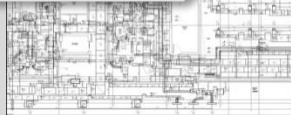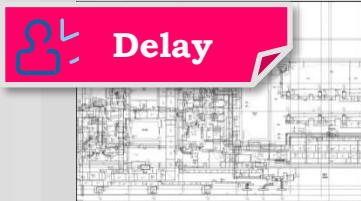
Offshore Plant - FLNG

1. Original Topside Module Clash Detection Process

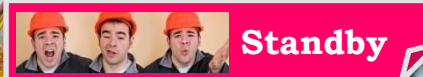### ① Clash Check
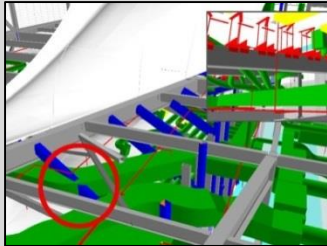
Clash check using 3D design model

Delay

Design

Find difference

On-site

Inaccurate

Check the clashes for different parts using tape

② Erection & Remove Clash parts

Cost

Erection

Standby

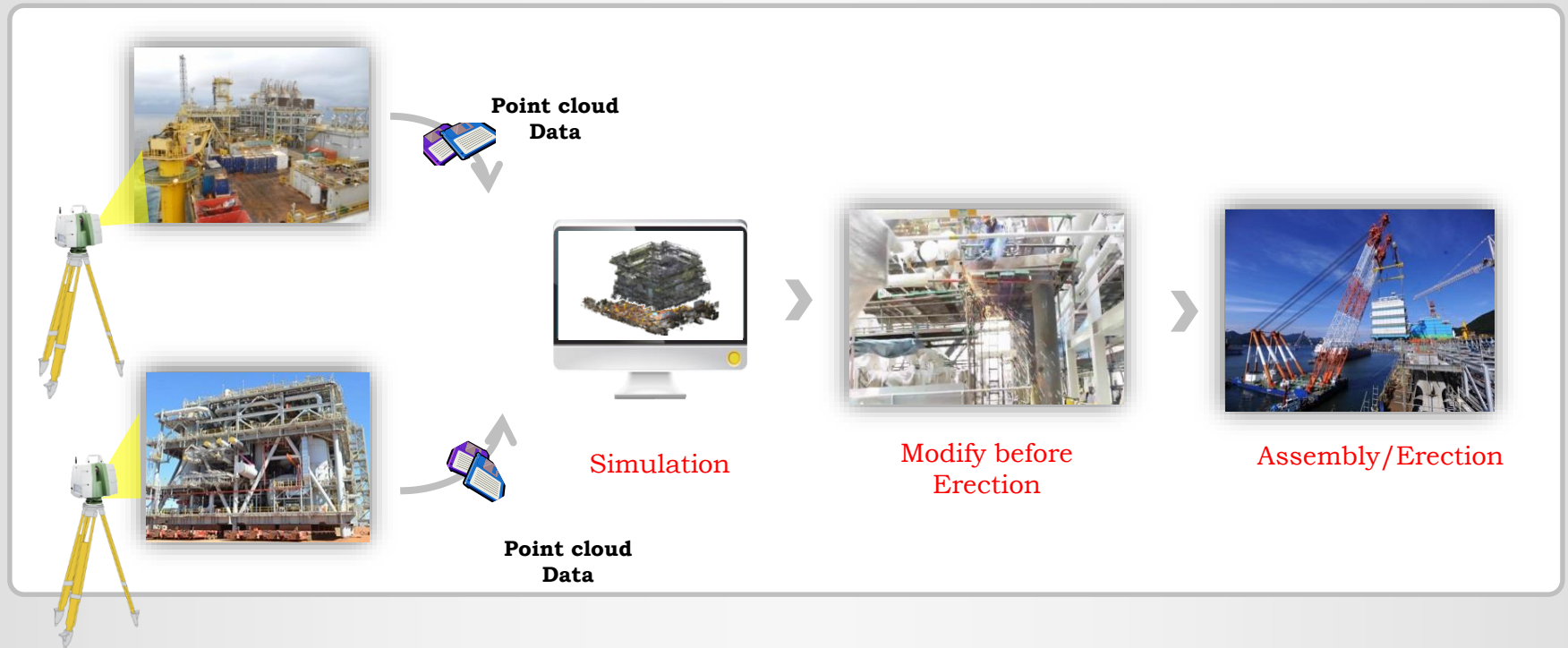

Remove clash parts

⚠ Unsafe

Clash ??

Offshore Plant - FLNG

2. Samin produced accurate Clash Detection simulation and report within **5 days per module** (Competitor's estimate was 3 weeks per module)

Point cloud Data

Simulation

Modify before Erection

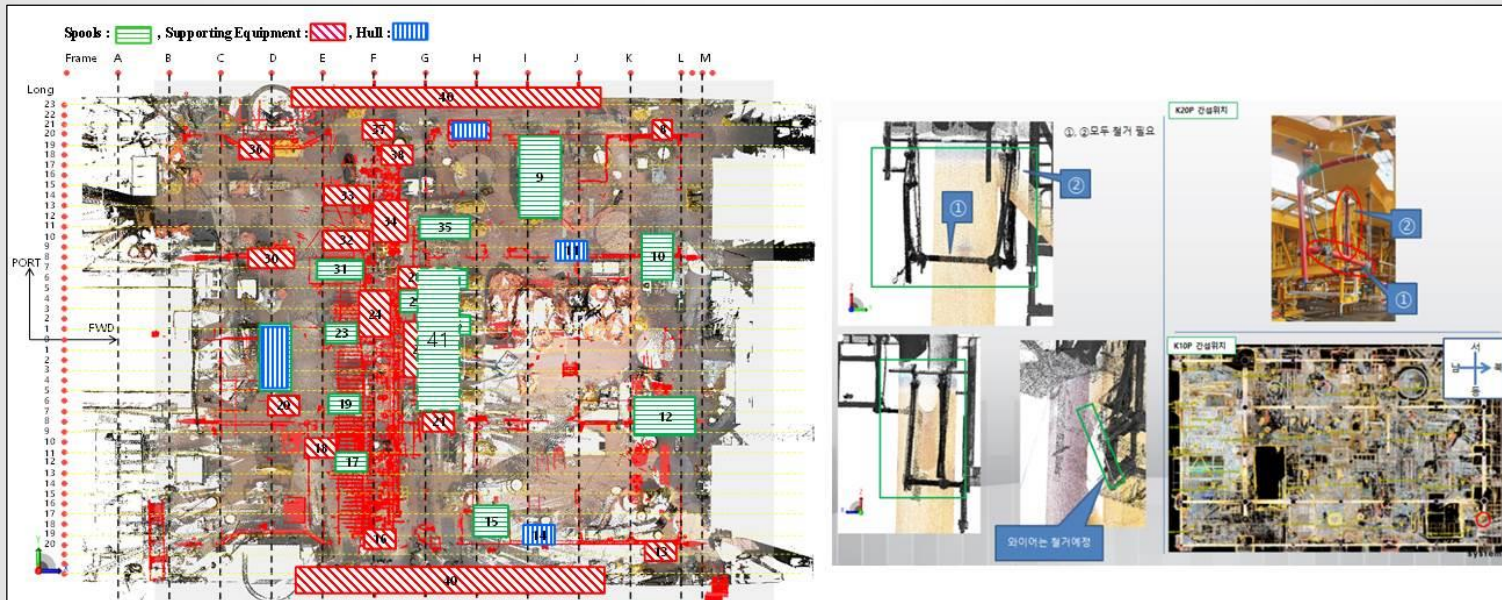Assembly/Erection

Point cloud Data

- Gathered accurate measurement using 3D scan
- Used Samin solution to prepare accurate simulation data
- Shared the result of simulation with production team.
- Determined where to remove and modify structure parts
- No interruption during fabrication

Offshore Plant - FLNG

3. Conclusion

<Report>

- Achieved 0 clash in all 13 modules

- Module erection time was reduced from 12 hours to average 3hrs
  (The shortest 40mins)

- Saved millions of dollars (ROI of 2,000%)

https://www.youtube.com/watch?v=F_xm5Ku5Nj8

Competitor Comparison

Some companies are proud of…
- Spending 8 days two person team for measuring 800 scan positions
- Spending 21 days 1 person scan positioning registration
- To produce only the Registered point cloud and TruView
For comparing 'design of gas plant' with 'to be integrated existing structure'

⚙ **SURVEYING EQUIPMENT**

Scanner Riegl VZ-400, Leica
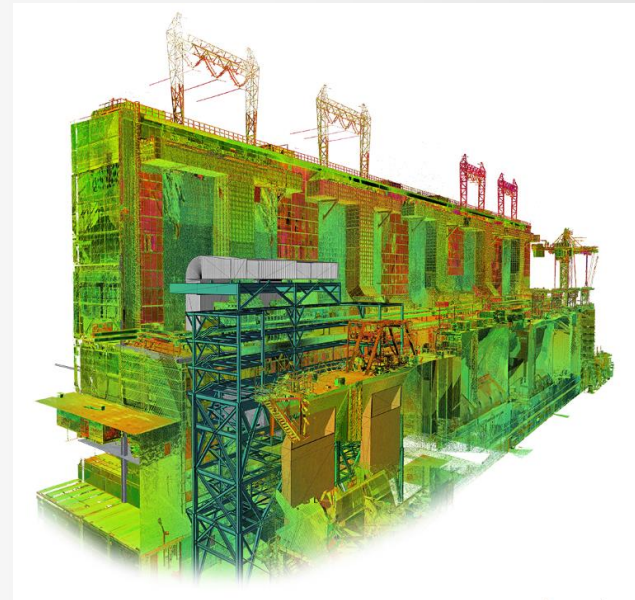TCRA 1101 plus Total Station

🕐 **TOTAL TIME SPENT**

8 days two person team over
800 scanpositions
21 days 1 person scan positions
registration

💼 **FINAL PRODUCT**

Registered point cloud and
TruViews

If they came to Samin, they would've had "Clash Simulation" result within 11 days!

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One more thing...

Samin Price Competitiveness

Costs **40%** less per day/person than F company

Costs **10%** less per day/person than A Company
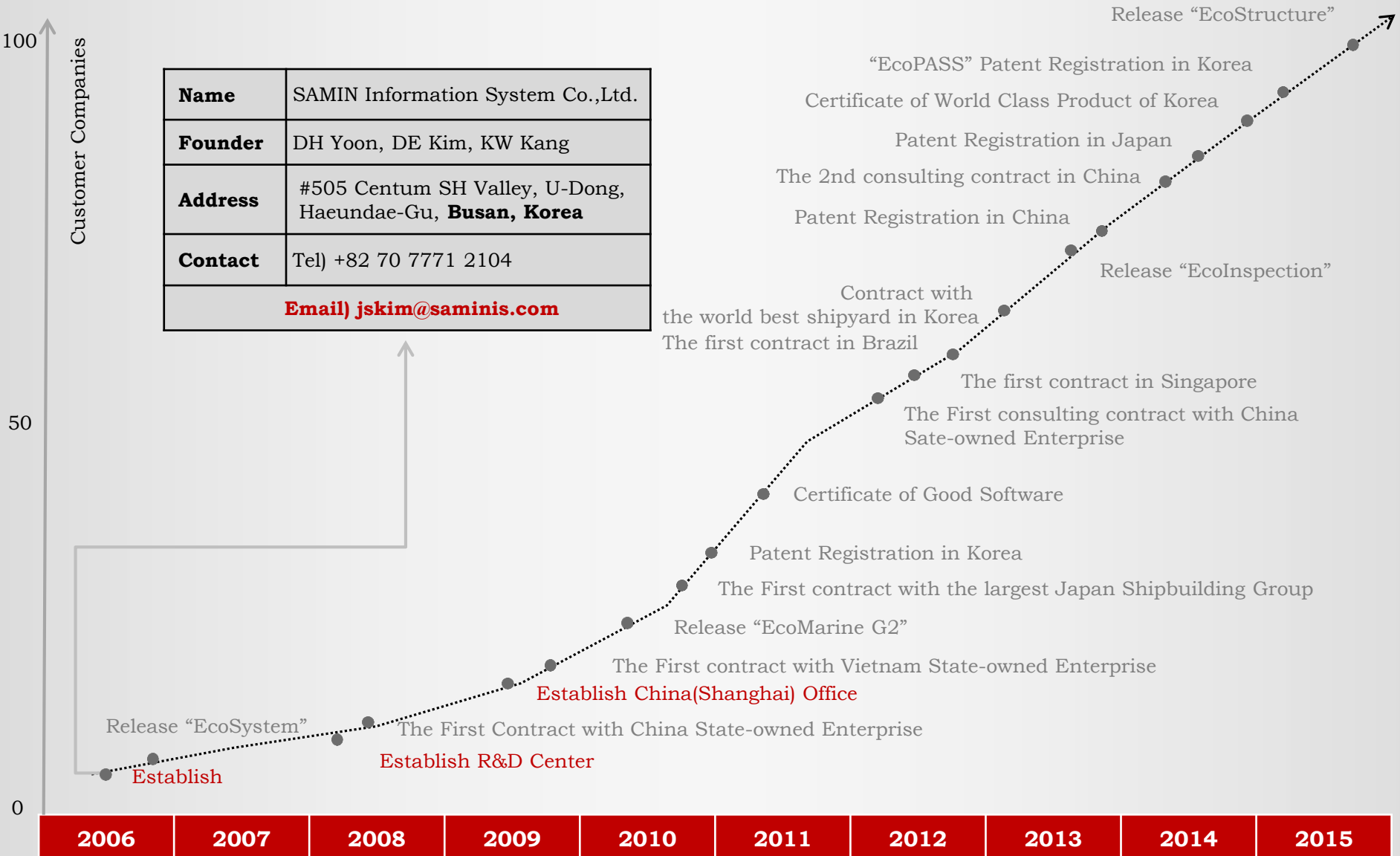
More than 50% Faster output than competitors

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Appendix

-Company History
-How Dimensional Control is conducted in Korea
-Process Flow

History

Customer Companies (y-axis)

100

50

0

Name	SAMIN Information System Co.,Ltd.
Founder	DH Yoon, DE Kim, KW Kang
Address	#505 Centum SH Valley, U-Dong, Haeundae-Gu, **Busan, Korea**
Contact	Tel) +82 70 7771 2104
Email) jskim@saminis.com	

Release "EcoStructure"

"EcoPASS" Patent Registration in Korea

Certificate of World Class Product of Korea

Patent Registration in Japan

The 2nd consulting contract in China

Patent Registration in China

Release "EcoInspection"

Contract with
the world best shipyard in Korea

The first contract in Brazil

The first contract in Singapore

The First consulting contract with China
Sate-owned Enterprise

Certificate of Good Software

Patent Registration in Korea

The First contract with the largest Japan Shipbuilding Group

Release "EcoMarine G2"

The First contract with Vietnam State-owned Enterprise

Establish China(Shanghai) Office

Release "EcoSystem"

The First Contract with China State-owned Enterprise

Establish R&D Center

Establish

| 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |

How Dimensional Control is conducted in Korea

- Conduct dimensional accuracy inspection of all block/module at the end of each stage.
- Defects found are not released to next phase.
- Korean heavy industries companies sporadically conduct dimensional accuracy inspection.
- Dimensional accuracy control policy enabled Korean heavy industries companies to build high quality of mega sized blocks and modules.
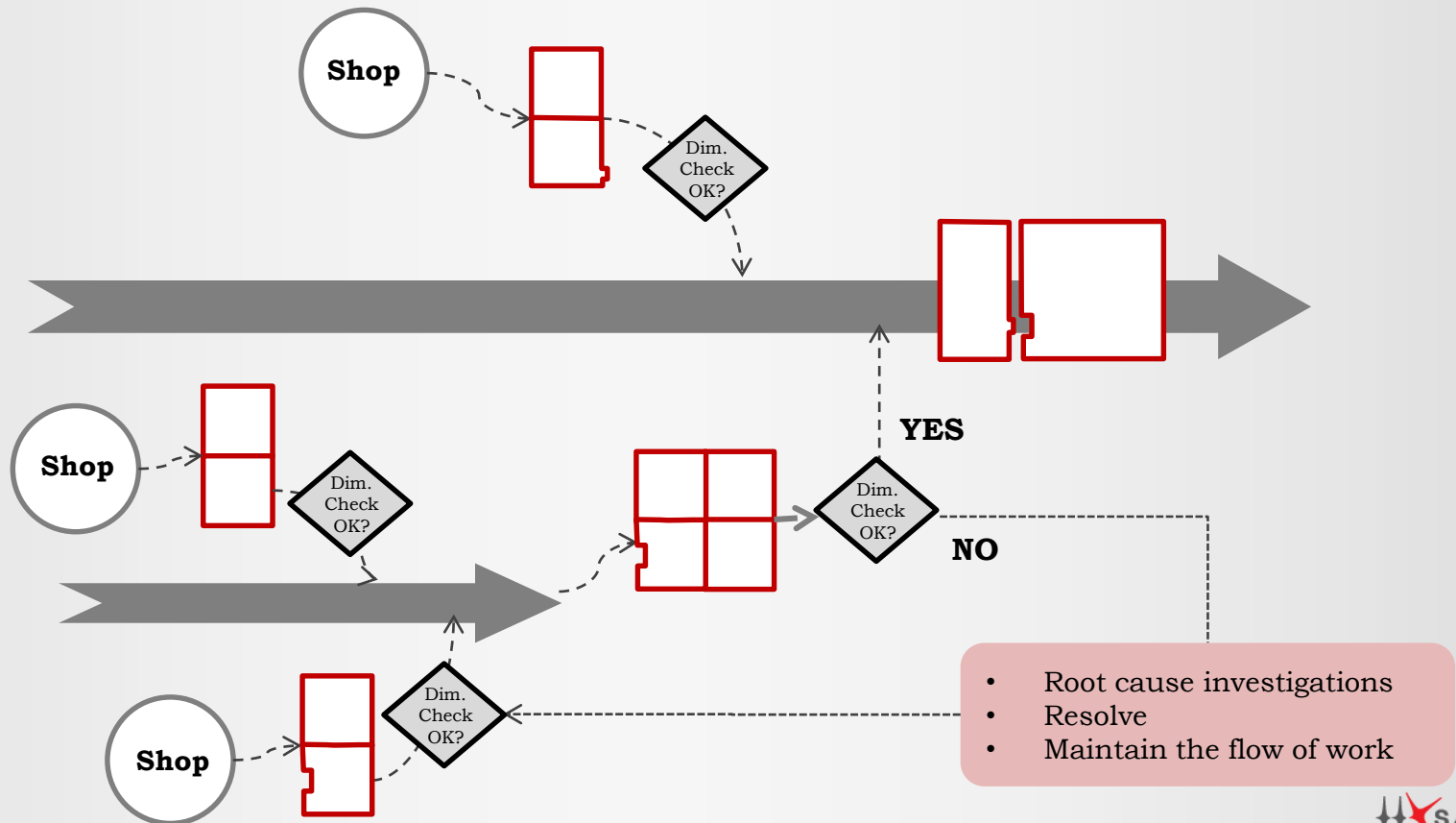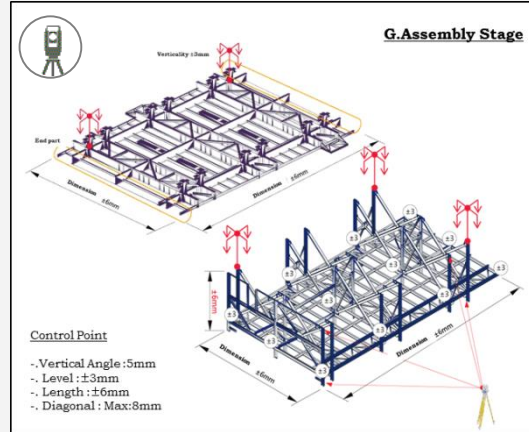
3D Dimensional Control Management Method

1. Prepare Dimensional Control plan for each module fabrication stage

- Select proper management methodology, device, and software for each stage and module type.

<Small size assembly – Manual Check>
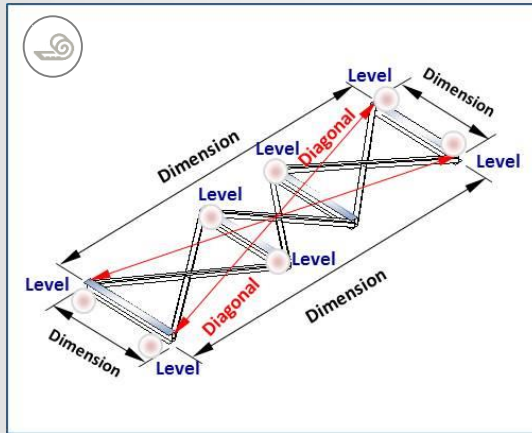
<Mid to Large Size Assembly – 3D measurement>
(Length, Vertical degree, Level, Deformation check)
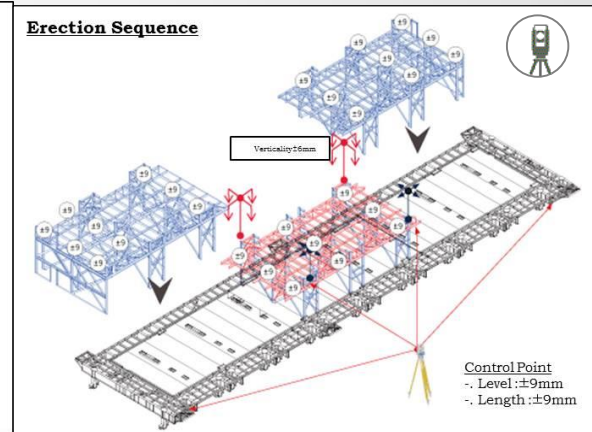
<Erection/Installation- 3D measurement>
(Datum point based erection/installation simulation S/W)
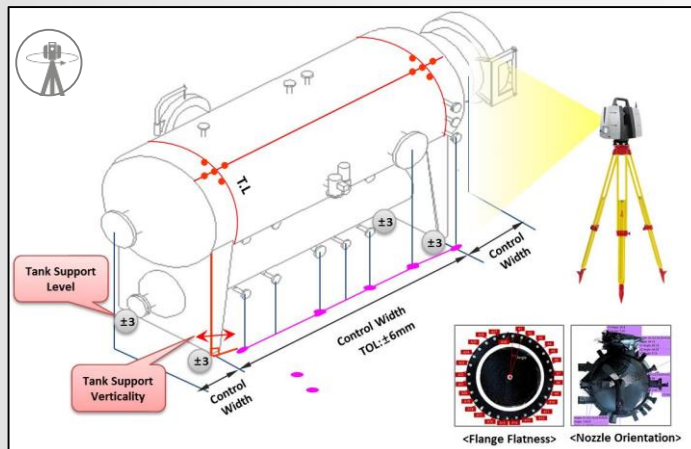
<Round and complicated structure>
(3D laser scanning Dimensional Control S/W)

<Set datum points and direction of final module installation>
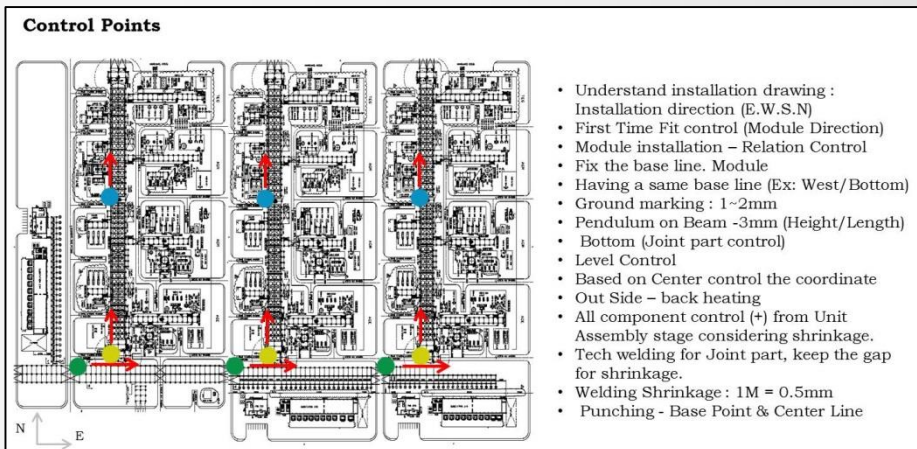
3D Dimensional Control Management Method

2. Acquisition of dimensional data of fabricated modules

- Determine the equipment type and method baed on structure type and management point
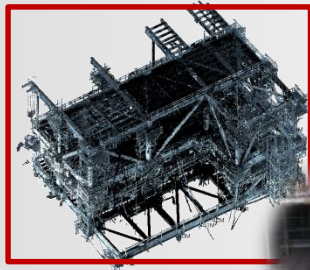
Piping Module
-3D Laser Scanning
(Acquire central focal point)

Focal Point

Large Column
-3D Laser Scanning

Module
-3D precision measurement
using Total Station

Measurement Point

3D measurement software 소프트웨어
(Instant access to measured data using Mobile and PDA)

Pipe Rack
-3D Laswer Scanning
(for Pipe Rack Alignment Check

3D Dimensional Control Management Method

3. Measurement Analysis
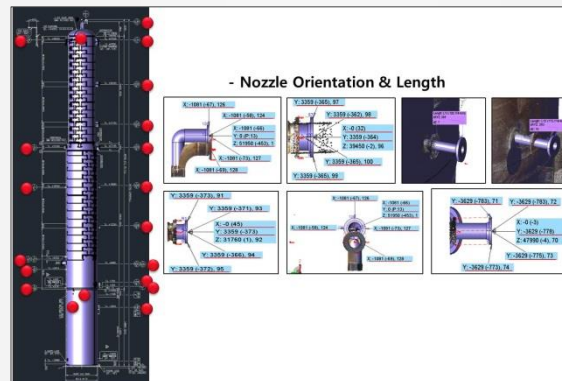
- Verify As-Built measurement against design and tolerance

Module 3D measurement & Reporting
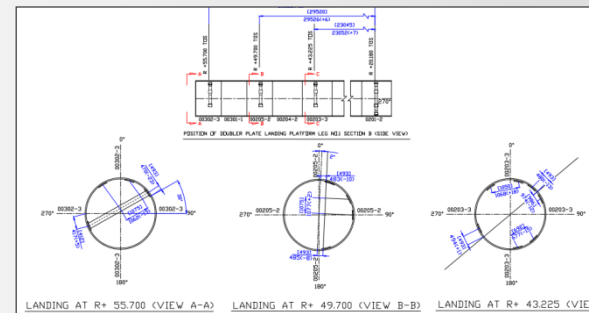**(3D Design vs. 3D Measurement)**
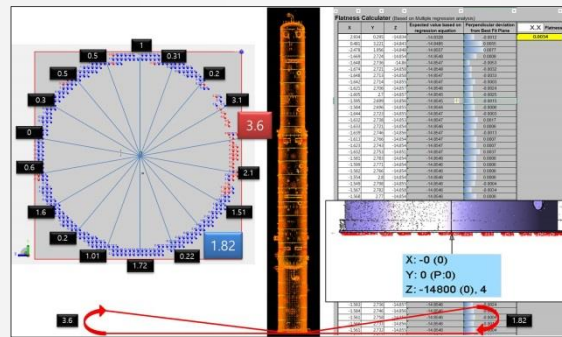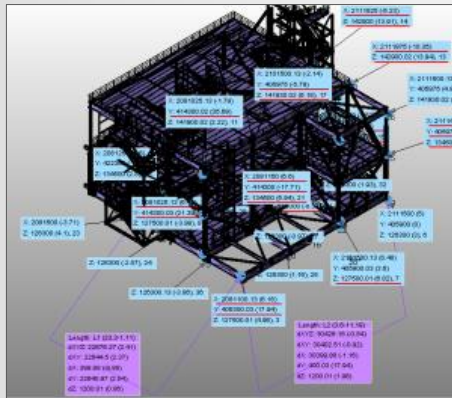
Support Ring Angle & Flatness

Column 3D Measurement
(3D Design vs. 3D Laser Scanning)

Nozzle A   Nozzle B   Nozzle C

3D As-Built Measurement- Nozzle Orientation
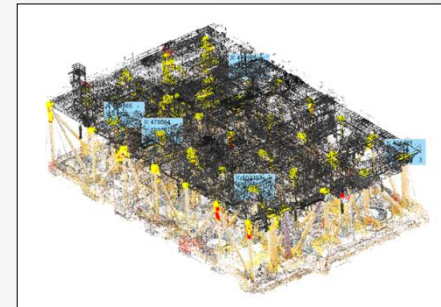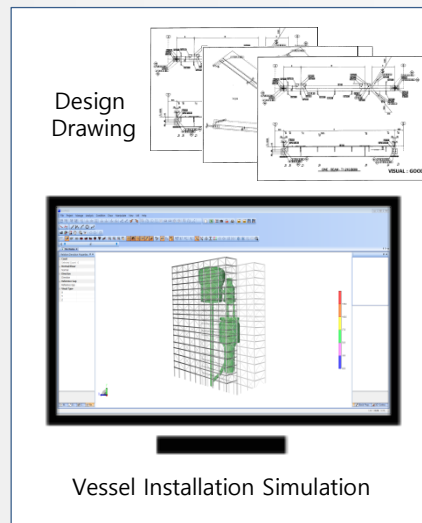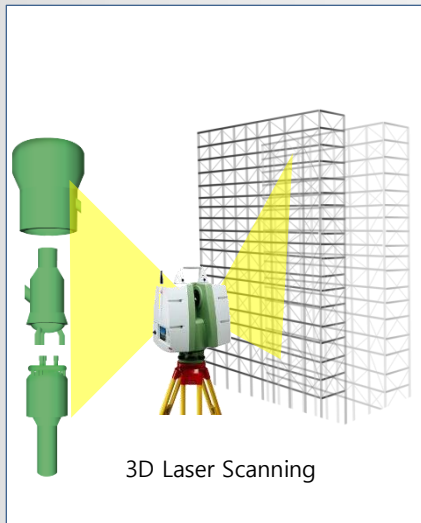**(3D Laser Scanning Data)**

Tubler As-Built Measurement Verification
(3D Measurement)

3D Dimensional Control Management Method

4. Module Erection/Installation Simulation

- Clash detection simulation using gathered data

- Plan best path and location for module installation/erection

- Modify any clash points before installation/erection

- Apply weight offset value during operation as needed

3D Laser Scanning

Design Drawing

Vessel Installation Simulation

3D Clash Detection

Modify before erection

First Time Fit

Joint Alignment Simulation
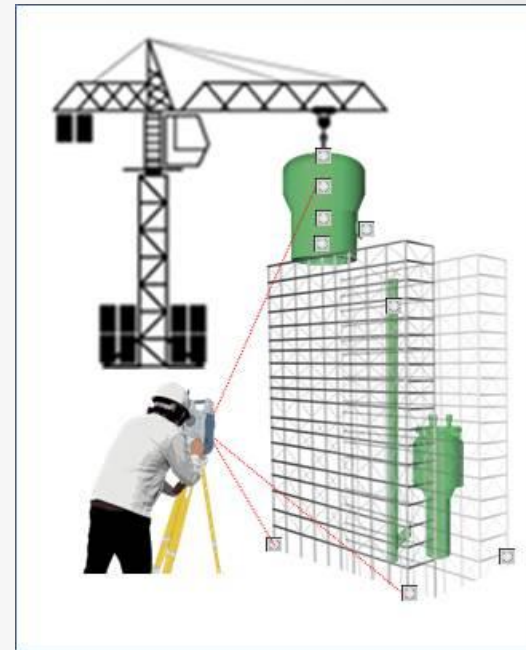
First Time Fit

SAMIN
information system
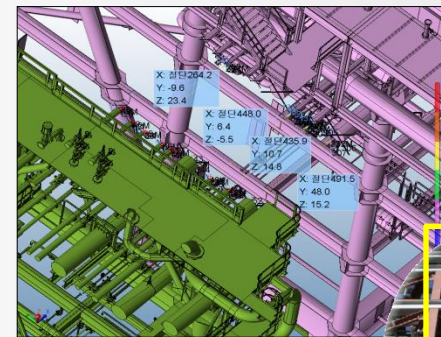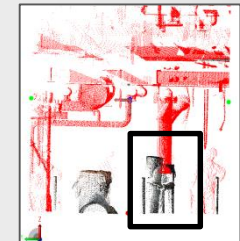
3D Dimensional Control Management Method

5. Dimensional Control during Module Installation/Erection

- Simulation based module installation/erection check
- Verify the position and setting of module during installation/erection

<Pipe rack Erection Check>
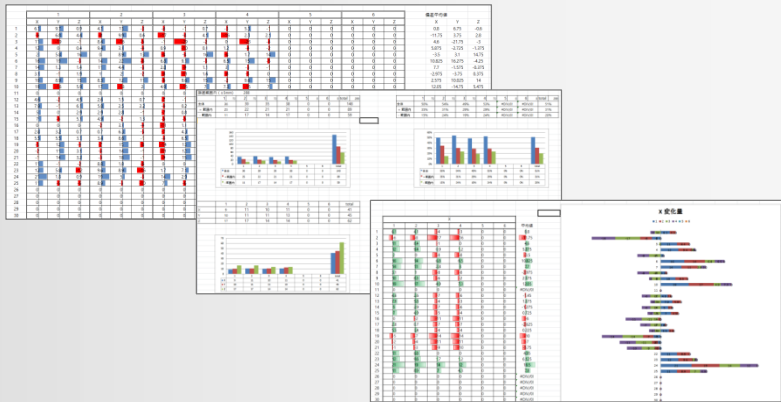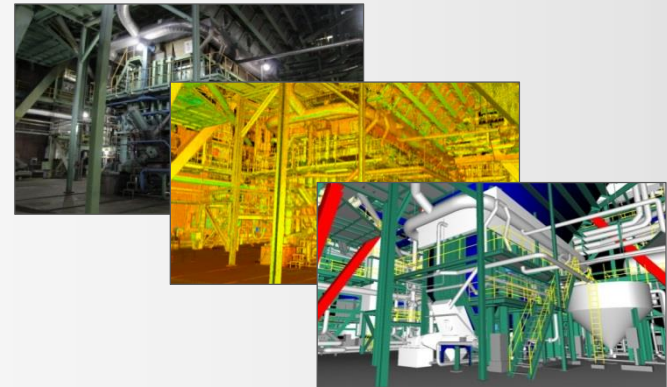
<Vessel Installation Check>
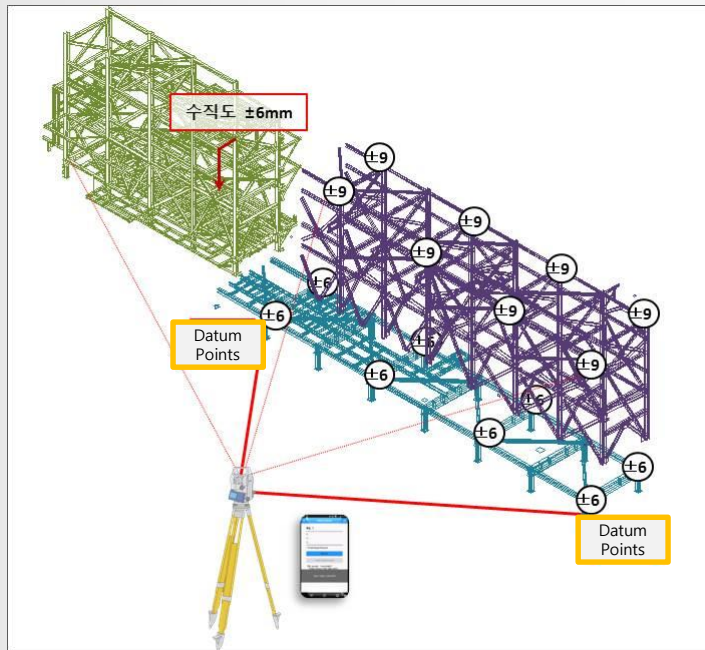
3D Dimensional Control Management Method

6. Module As Built Data Analysis and Management

- Check metal expansion/shrinkage after welding using phase based measurement data

- Analyze measured data against tolerance level

- Periodic deformation check during operation and transport

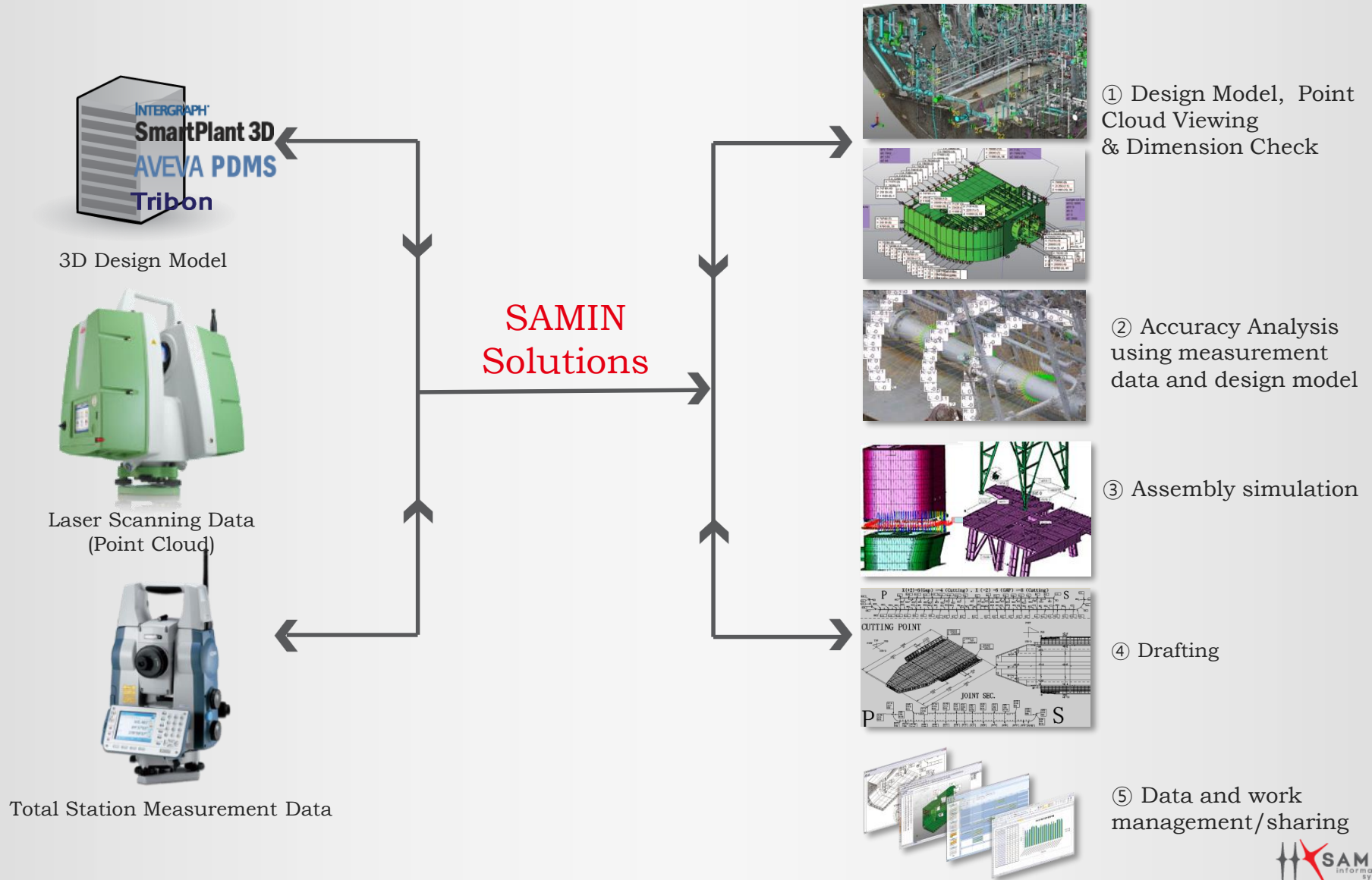- Utilize data gathered during maintenance, revamp, and retrofit

<Statistical analysis of phase based measurement >

<As-Built data utilization >

Utilize SAMIN Software Solution to Process Flow

3D Design Model

Laser Scanning Data
(Point Cloud)

Total Station Measurement Data

SAMIN
Solutions

① Design Model, Point
Cloud Viewing
& Dimension Check

② Accuracy Analysis
using measurement
data and design model

③ Assembly simulation

④ Drafting

⑤ Data and work
management/sharing

Utilize SAMIN Software Solution to Process Flow
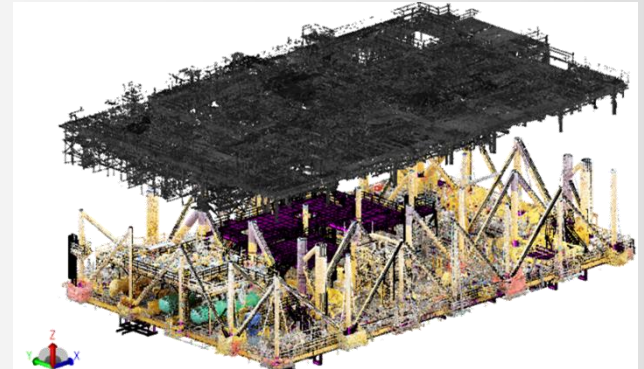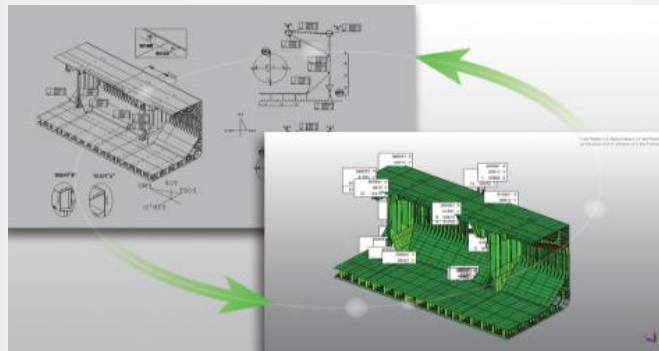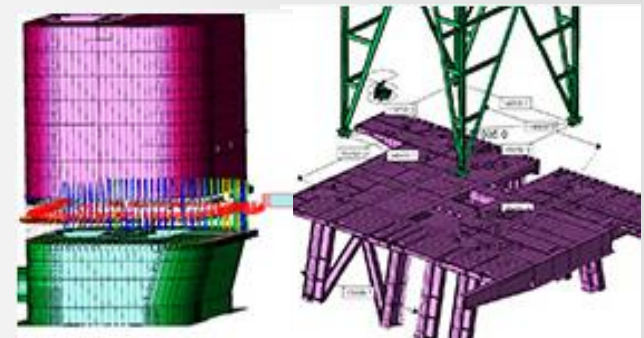
Q&A

Thank you.

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