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Six Sigma Innovative Material Solutions for Telecommunications Industry

Robert Johnson
GE Plastics



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Six Sigma Basic

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- **Process...** Everything Is Process
- **Correlation...** $Y = f(x_1, x_2, x_3)$
- **Discipline...** DMAIC
- **Data ...** All Learning Resides In It

The Sooner A Team Understands This Is How
The World Works ... The Better The Chance For Success



D-M-A-I-C

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**For Each Product or Process CTQ –
Define, Measure, Analyze, Improve, and Control**

$$Y = f(X)$$

Define 1. Customer expectations of the process?

Measure 2. What is the frequency of defects?

Analyze 3. Why, when, and where do defects occur?

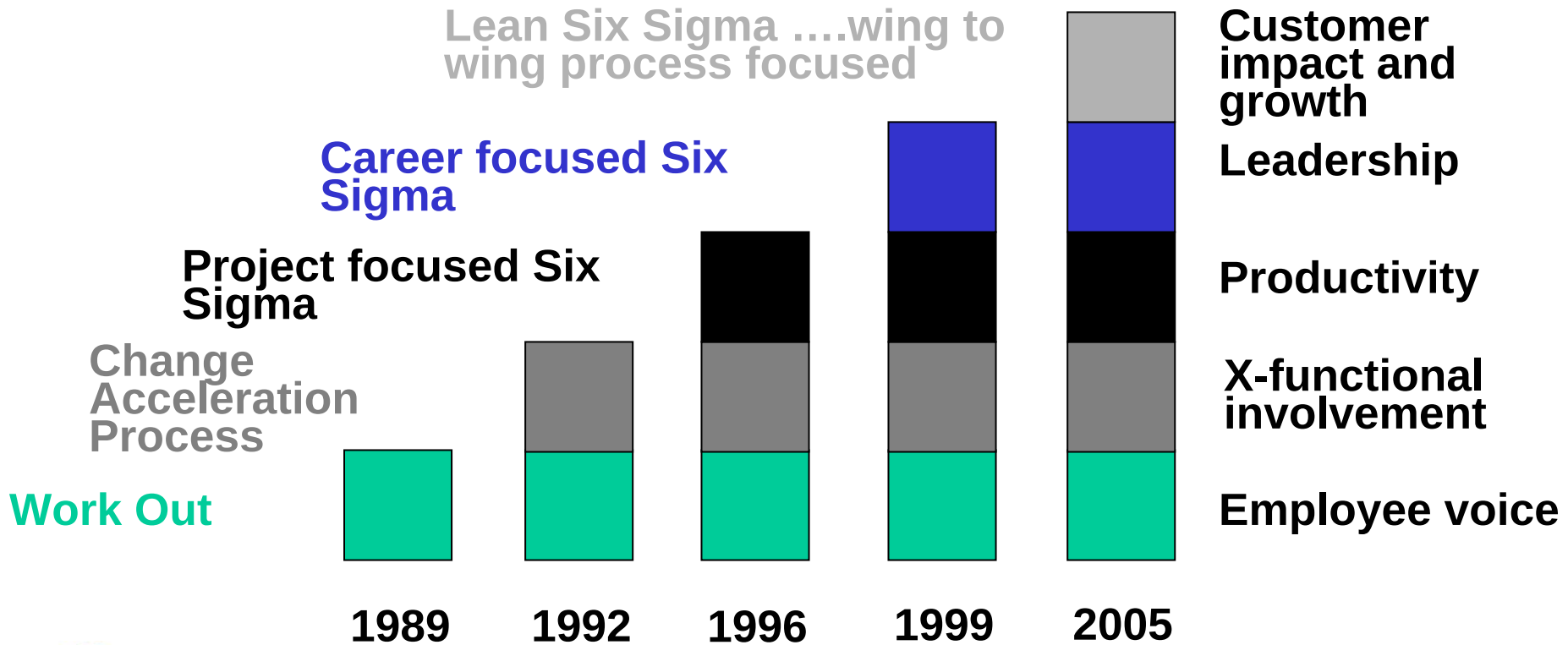
Improve 4. How can we fix the process?

Control 5. How can we make the process stay fixed?



Evolution of GE Change Processes

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... Back in 1995

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Why Start 6 Sigma AT GE?

- 1. Our Customers became more demanding on Quality***
- 2. CEO survey said that our People wanted a Company Initiative to address concerns on Quality***
- 3. Culture change***

What's The Power Of 6 Sigma?

- 1. Broader than existing Quality programs***
 - It impacts all our Business Processes***
- 2. Connects Quality & the Bottom Line***
 - And therefore changes the way we work***

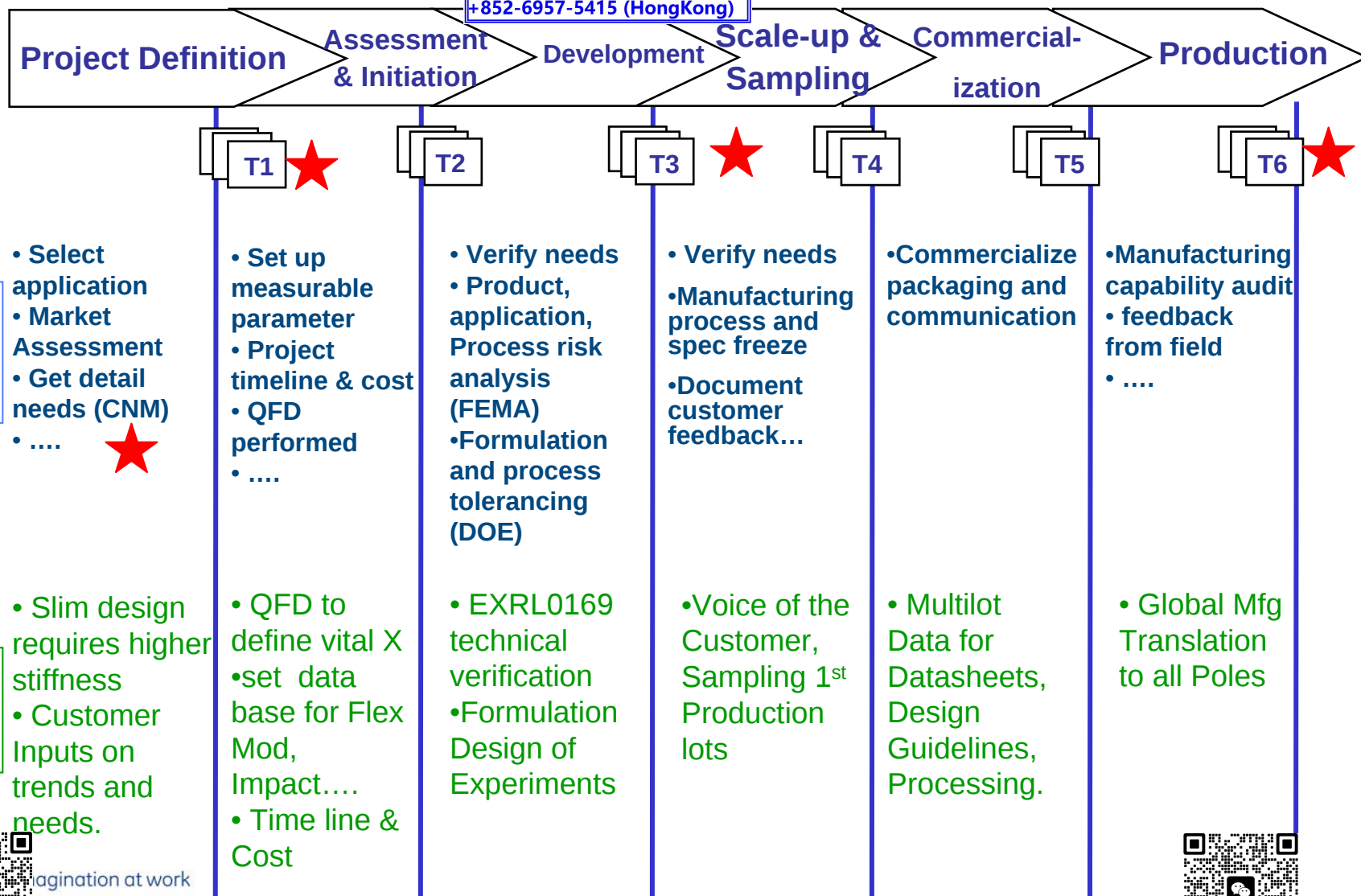


Imagination at work



NPI = New Product Introduction

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★ Customer Touch Points

Customer Innovation Process

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PHASE 1 Customer Needs

Trend Analysis
Teardown



**Market
Knowledge
; Needs**

Customer Innovation Process

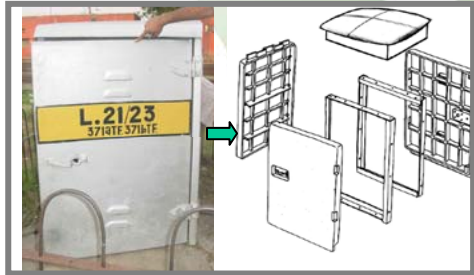
PHASE 1 Key Learnings

Documentation
Implementation



PHASE 2 Concept

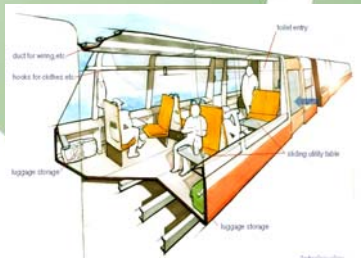
Brainstorming
Assessment



**Alternative
Solutions;
Concepts**

PHASE 3 Design Development

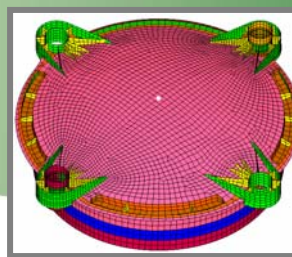
Visualization
Part Design



**Creativity & Innovation;
Feasibility**

PHASE 4 Predictive

Engineering Analysis
Optimization



**Performance &
Results;
Predictive Analysis**

PHASE 5 Validation

Prototyping
Real-Life Testing



**Validation;
Proven Success!**

**Results Delivered
Real Parts**



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...using six-sigma processes and rigor

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GE Material

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6 Sigma Solutions for Telecommunications

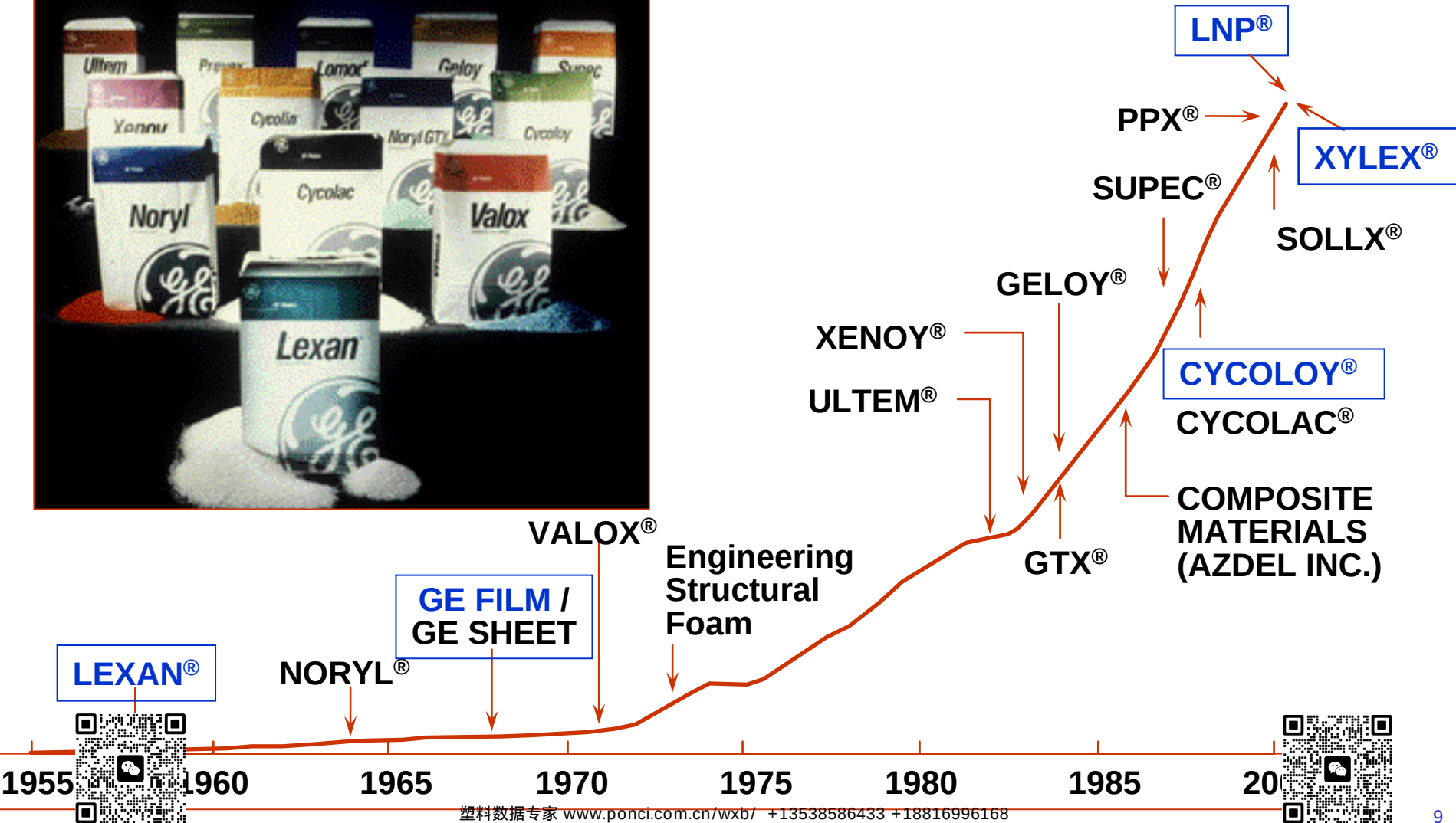


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GE Product Portfolio & Material for Mobile Phone

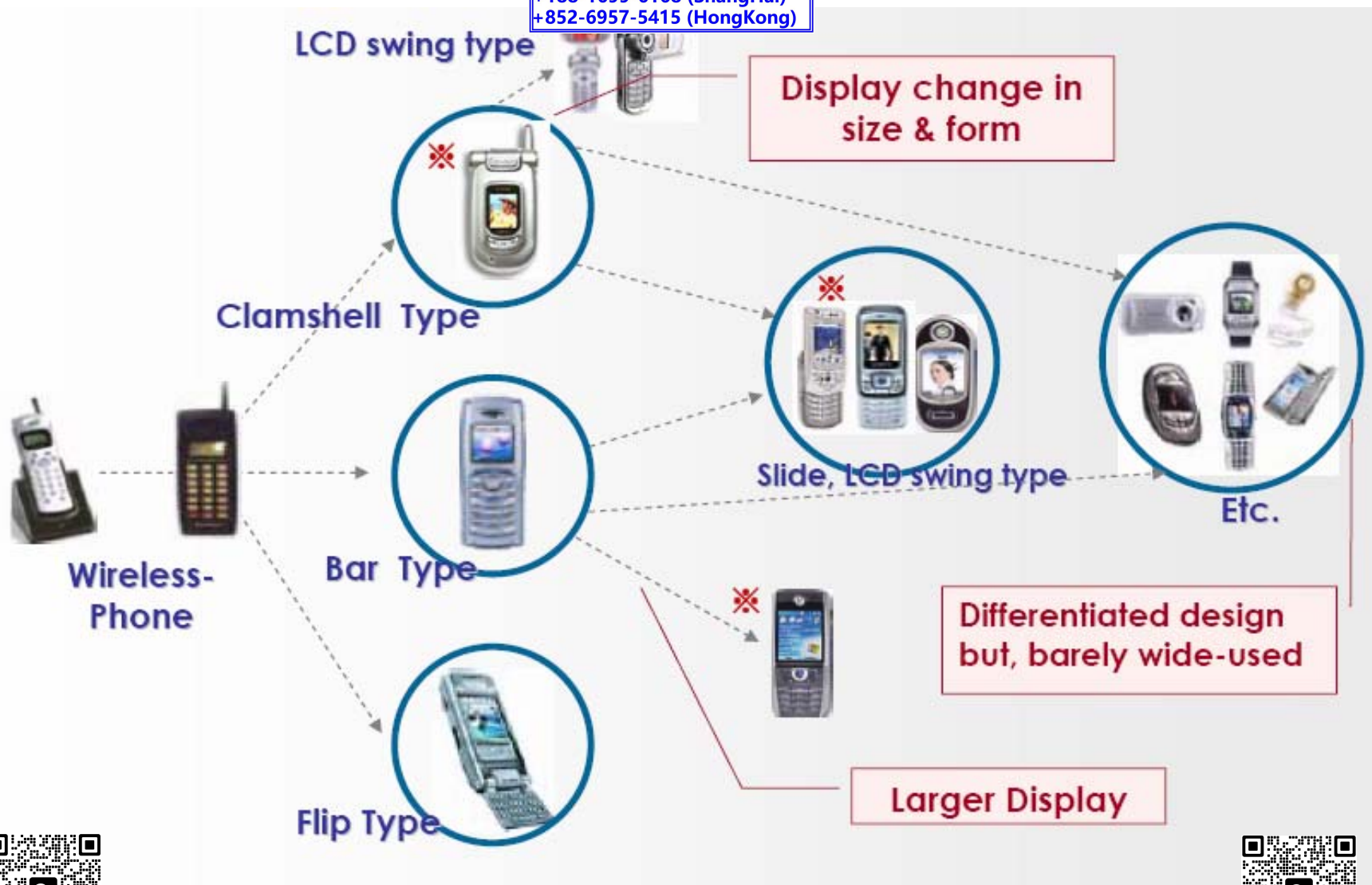
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The Evolution of Mobile Platforms

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Platform and Model “Life Cycle” Shortening

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Mobile Phone Applications Overview

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Hinge-LNP LUBRICOMP* UCL-4036A
(wear resistance, high stiffness)

Camera lens barrel
LNP STAT-KON* DC-1004 (dimensional Stability, anti -static),
LNP THERMOCOMP* UF-1009

C Cover- Lexan* EXL
(Excellent strength)

C Cover – LNP VERTON* PDX-U-03320
(high stiffness, ductile)

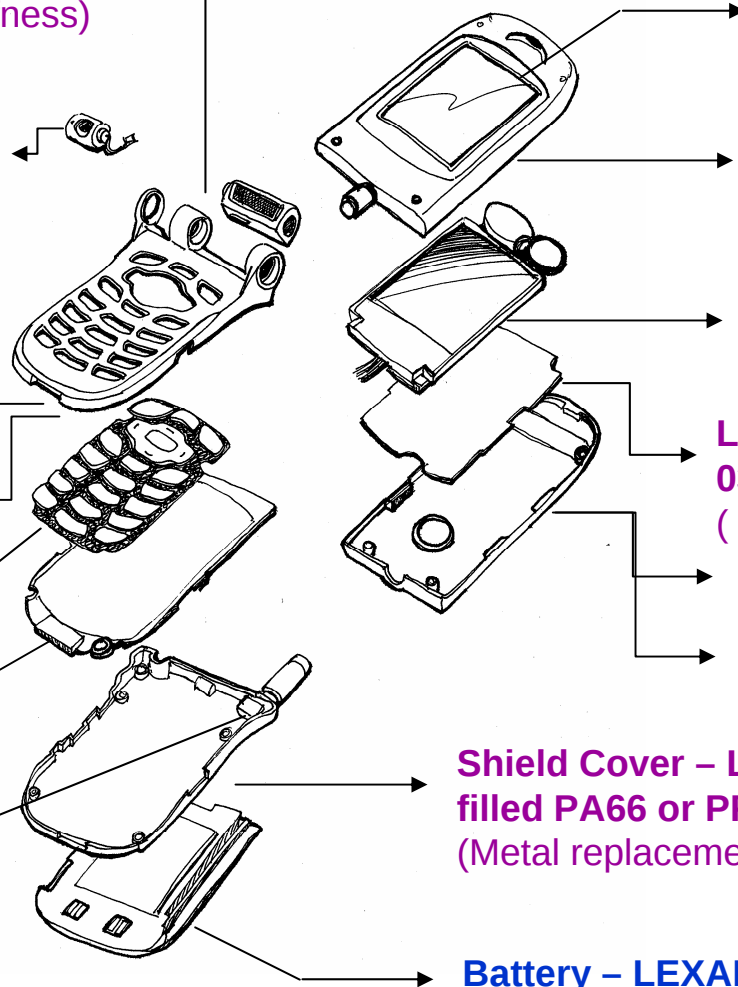
Keypad –Lexan*

PCB

Antenna – Cycoloy* MC1300



Imagination at work



Lens – Xylex* X7300CL
(Clarity, Chemical Resistance)

Lens – Film

B Cover – Lexan* EXL1414 (Excellent strength)

Light Guide – Lexan* EXL1810T
(Clear, High Flow)

LCD Bracket – LNP VERTON* PDX-R-03579
(high stiffness, metal replacement)

A Cover – Lexan* EXL1414

A Cover – Film

Shield Cover – LNP VERTON* long glass fiber filled PA66 or PPA
(Metal replacement, high stiffness and impact)

Battery – LEXAN* EXL (excellent strength)

CYCLOLOY* CX7240 (high flow, excellent strength)



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*LEXAN, XYLEX and LNP STAT-KON are trademarks of the General Electric Company

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The Need for 6-Sigma.

Enables Speed in the New Product Development Process

- Clearly defined targets for needed properties.
- Voice of the Customer engagement.

Drives Product Quality

- Consistency of raw materials
- Process control and improvement in manufacturing

**Drives the development of the right product....
quickly and consistently!**



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GE Material

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LEXAN* EXL



GE imagination at work

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LEXAN* EXL Resin

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LEXAN™
Resin Technology



A whole new generation
of performance.

- New compounded polycarbonate
- Special copolyester
- Excellent Transparency and Chemical resistance

The silicon brings

- Low Temperature Impact
- Good weather ability
- Good release performance
- Chemical resistance**

Polycarbonate

- High-impact resistance
- Ductility
- High-temperature resistance

No free silicone



Low plate out
No juicing



Information at work

A Unique GE Product offering

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XYLEX*



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XYLEX* Resin a new blend ...

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XYLEX™
Resin Technology



A whole new generation
of performance.

- Polyester Blend Technology
- Special copolyester
- Excellent Transparency and Chemical resistance

Special Copolyester

- Chemical resistance**
- Superior flow
- Great weatherability
- UV Transparent
- Low Processing Temperature

Polycarbonate

- High-impact resistance
- Ductility
- Clarity
- High-temperature resistance



* resistance to be verified against used substances

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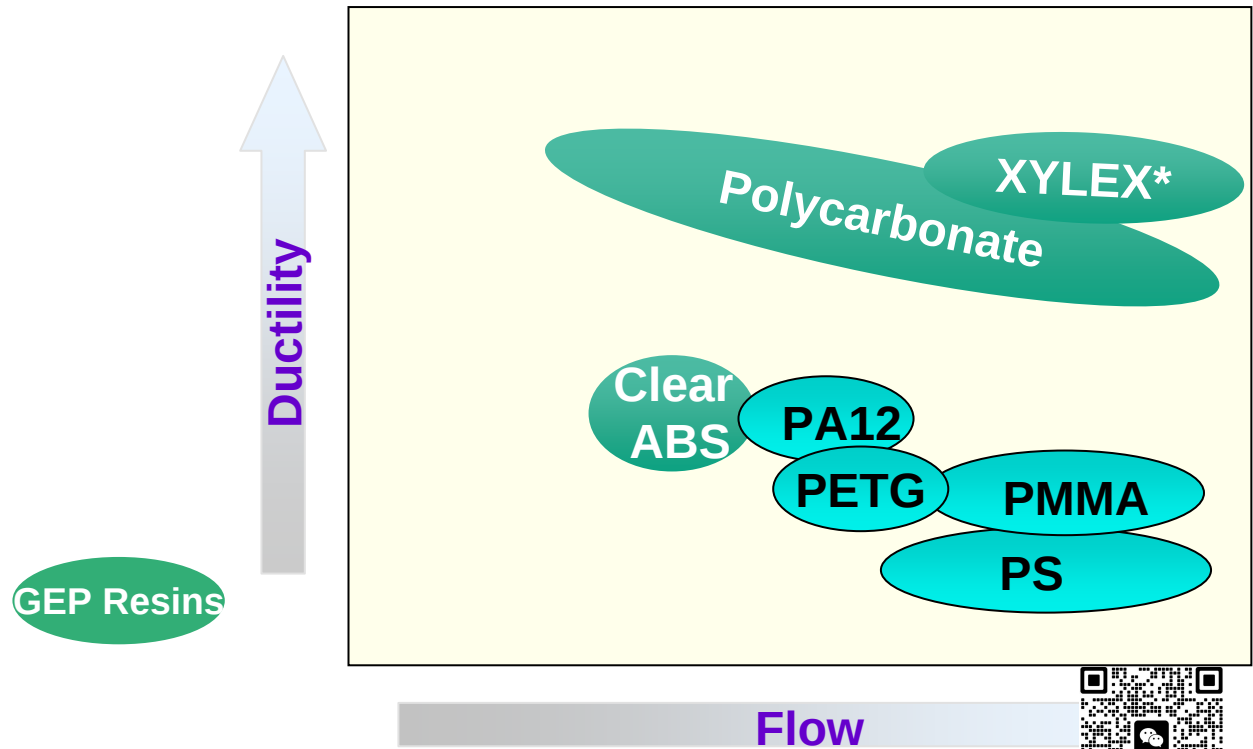


XYLEX* Resin

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Ductility versus Flow

XYLEX* Resins provide a superior balance of ductility and excellent flow



Imagination at work

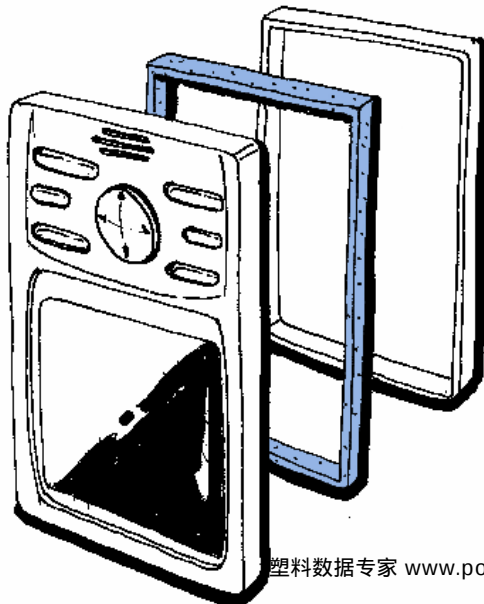


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GE Material

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LNP VERTON* LNP LUBRILOY*



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LNP Products

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What are LNP Products?

- Compounds of thermoplastics and fillers and reinforcements designed to deliver specific end-use effects:
 - **wear resistance and lubricity**
 - **electrical conductivity & thermal conductivity**
 - **strength stiffness & impact**
 - **dimensional control, tight tolerance**
- All thermoplastic resins (except PVC)
- Most fillers you can think of



Diversity ...



LNP VERTON*

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Long Glass fiber filled composites

Industry Trends

- Multi-functional
- Larger Display Window
- Design Freedom
- Small mechanical Size and robustness
- Cost requirement

Application requirement

- metal to plastics
- Increase stiffness
- High impact
- Dimensional stability

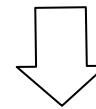
Metal replacement Solution

High stiffness & impact

VERTON* PDX-R-03579 (PA66+LGF)

VERTON* PDX-U-03320 (PPA +LGF)

VERTON* PCA-F-7004 EM
(PC/ABS+LGF)



Potential Applications

Mobile phone internal & structure parts

-LCD Frame

-LCD Bracket

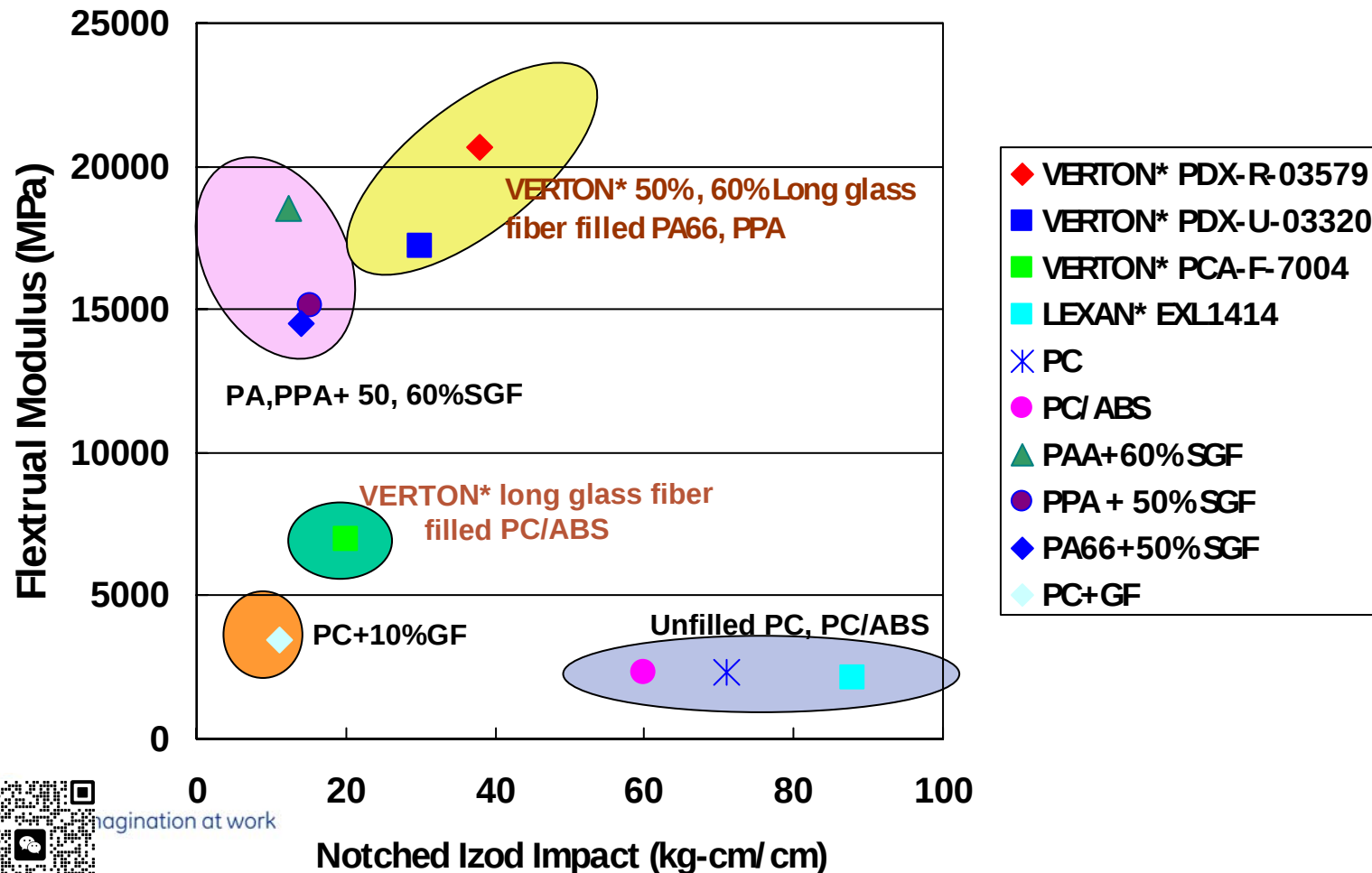
-Shield Cover

-Replace metal cc



LNP VERTON* – provides good combination of stiffness and impact

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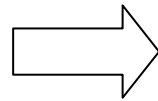
LNP LUBRICOMP* and LUBRILOY*

Wear resistance solution

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Design trend: More flip& slide phones

More moving parts
- hinge for flip phone
- Slider
- movable covers



Low wear material
LNP LUBRICOMP*
LNP LUBRILOY*

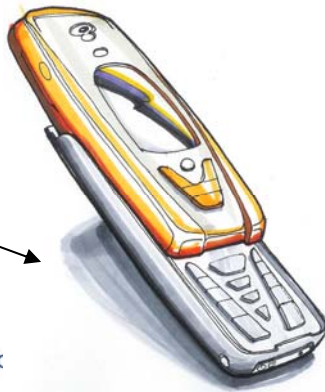
PC/ABS, PC, PA, PPA
+
PTFE or PTFE/ Si

PC/ABS, PC, PA, PPA
ALLOY

Wear + Stiffness

PC/ABS, PC, PA, PPA
+
PTFE or PTFE/Si
+
carbon fiber or GF

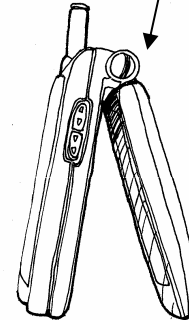
Slider



Battery cover



hinge





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Simple Principles for Success:

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- **Discipline...** DMAIC
- **Data ...** All Learning Resides In It

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The World Works ... The Better The Chance For Success

