2nd World Quality Forum of the International Academy for Quality

Ishikawa Memorial Lecture:

Intranet of Qualities (IoQ) for Quality Assurance in THE DIGITAL ERA

October 13, 2017
Bled, Slovenia

Dr. Noriaki KANO
Professor Emeritus, Tokyo University of Science
Honorary Member, International Academy for Quality

Profile of Dr. Noriaki KANO

(as of June 2016)

Credentials: - Professor Emeritus, Tokyo University of Science, Doctor of Engineering (University of Tokyo)

Engagements: - Honorary Chairperson (2005-), 2002-04 Chairperson, Asian Network for Quality (ANQ)

- Chairman(2011-), Selection Committee for Deming Prize for Individuals, 2004-07 Chairman, Deming Application Prize Committee, 1978- Committee Member, Deming Prize Committee
- Lecturer(1964-), Board Member(2000-), Union of Japanese Scientists and Engineers (JUSE)
- Lecturer(1976-), 2007-12Board Member, The Overseas Human Resources & Industry Dev't Association (HIDA)

-Honorary Member(2010-), 2000-02 President, 1971- Member, Japanese Society for Quality Control (JSQC)

- Honorary Member(2012-), Principal Counselor (2012-), Indian Society for Quality(ISQ)
- Foreign Honorary Advisor(2006-), China Association for Quality (CAQ)

Honorary Member, ASQ(2014-), 1995-2014 Fellow, 1975-93 Member, American Society for Quality (ASQ)
http://asq.org/about-asq/who-we-are/honorary-members.html

- Honorary Member(2014-), 1993-2014 Academician, International Academy for Quality (IAQ)
- 2003-09 Corporate Auditor of Sekisui Chemical Ltd.,
- 2006-12 Chair Professor, 2006 Honorary Doctor, Chungyuan Christian University(CYCU,Taiwan)
- 2008-14 Board Director, Komatsu Ltd - 2006-09 Advisory Professor, Tongji University (Shanghai)

Dr. Kano was invited for research, lecture, and consultation by domestic and overseas quality related organizations. The number of the countries he has visited reaches over 70 countries.

Publications: Over 300 papers books including "Attractive Quality"(Kano Method / Kano Model)", "Guide to TQM in Service Industries" (in English) and "Way to Breakthrough and Creation" (in Japanese)

Honors: - 2014 A. V. Feigenbaum Lifetime Achievement Medal, 2004 Harrington-Ishikawa Medal（APQO)

-2016 Georges_Borel_Award for International Achievements by European Organization for Quality(EOQ)

- 2012 Honorary Member, 2008 Dronacharya Award by Indian Society for Quality (ISQ)
- 2010 Ishikawa-Kano Award Established by Asian Network for Quality (ANQ)
- 2009 Kano Quality Award Established by Technological Promotion Association (TPA, Thailand)
- 2009 Distinguished Service Medal, 2006 E. L. Grant Medal、and 2002 E. Jack Lancaster Medal (ASQ)

-2006 Honorary Doctor, Chungyuan Christian University(CYCU, Taiwan)

-1997 Deming Prize for Individuals by Deming Prize Committee (JUSE)

- 1997 Deming Lecturer by American Statistical Association (ASA) and many others

Work Experiences: - 1982-2006 Professor, Tokyo University of Sciences(TUS)

- 1970-1982 Lecturer & Associate Professor, The University of Electro-Communications

Education: Completed Undergraduate & Doctoral Courses, Engineering School, The University of Tokyo

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"Kaoru Ishikawa: The Man and Quality Control",

Translated into English

http://www.juse.or.jp/english/archives/ ,

http://www.juse.or.jp/english/ishikawa/04.html

[Major Honor]

- •1993: Foundation of the Ishikawa Medal, American Society for Quality Control
- •1990: Foundation of the QC Circle Kaoru Ishikawa Award, QC Circle Headquarters, JUSE
- •1988: The Order of Sacred Treasure, Gold and Silver Star, The Emperor of Japan
- •1986: Honorary Member, American Society for Quality Control
- •1983: Shewhart Medal, American Society for Quality Control
- •1952: Deming Prize for Individuals, Deming Prize Committee, JUSE

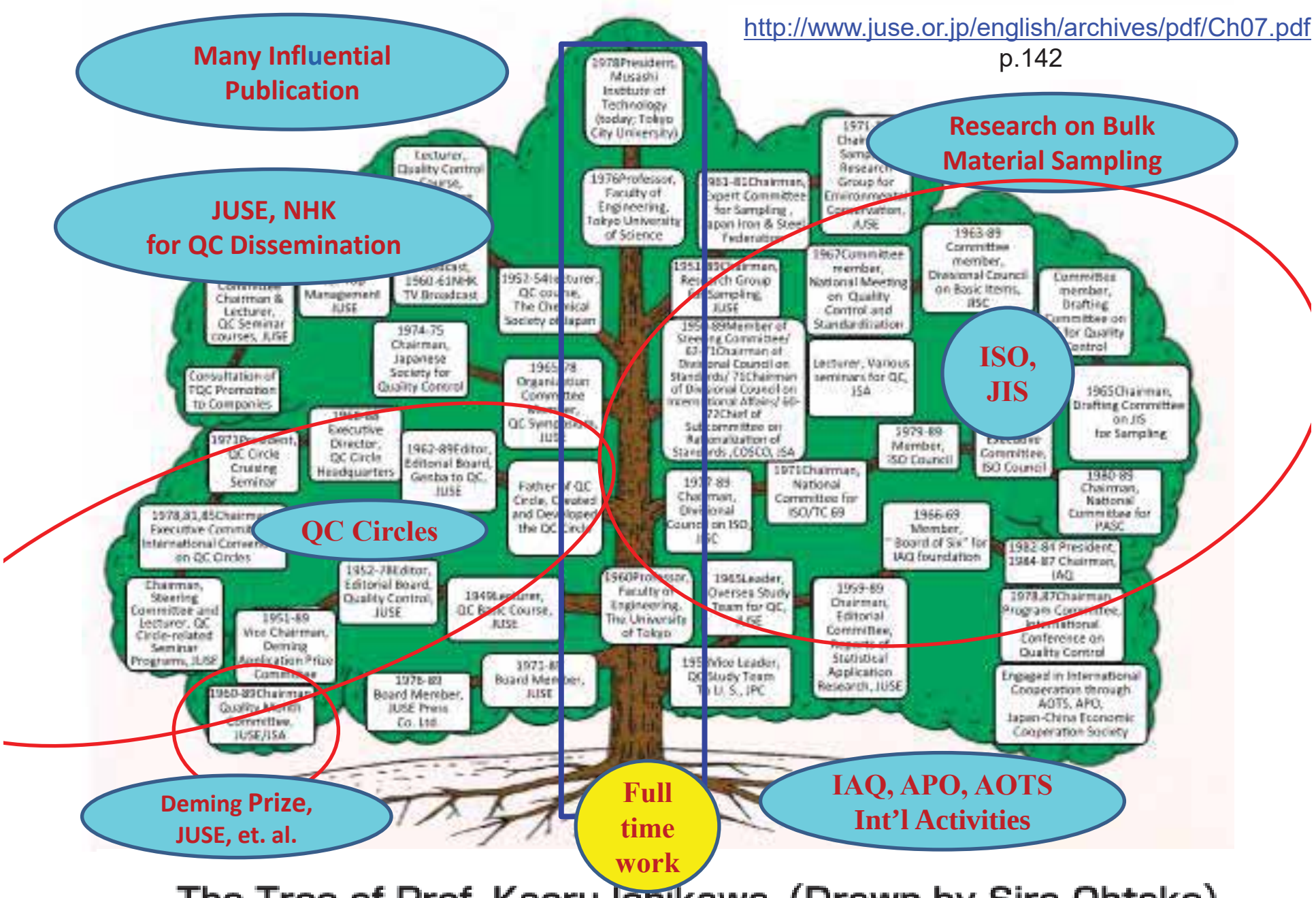
Contribution of Prof. Kaoru Ishikawa to develop the training program for the application of computers for quality control

Prof. Ishikawa took the strong leadership for starting a special course For the application of computers for statistical quality control with Prof. Shigeichi Moriguti, Professor of the University of Tokyo as follows:

Installed QC Computer Course (Saturday course for each month of the six months) attached to Basic Course of Quality Control (5-day course per every month for six months), JUSE, in October, 1966. This was continued the course ended in September, 1973.

The application of computers to Quality Control started with this course in Japan around the latter part of 1960s. However, the application of computers rapidly disseminated and then any special training by JUSE became unnecessary around 1973.

http://www.juse.or.jp/english/archives/pdf/Ch07.pdf
p.142



The Tree of Prof. Kaoru Ishikawa (Drawn by Siro Ohtake)

Representative Publication

-*Nihonteki Hinshitu Kanri* (Japanese-style Quality Control), JUSE Press, Ltd., 1981
[English] **What Is Total Quality Control? The Japanese Way,** Prentice Hall Inc., 1985

-***QC Circle Koryo* (QC Circle Platform),** QC Circle Headquarters, JUSE, 1970
[English] QC Circle Koryo, General Principle of the QC Circle, QC Circle Headquarters, JUSE, 1980

-*Genba no QC Shuho* (On-site QC Methods) JUSE Press, Ltd., 1968
[English] **Guide to Quality Control** (1st ed., 1974; rev. ed., 1976; 2nd rev. ed., 1982), Asian Productivity Organization

-*Hinshitu Kanri Nyumon* (Introduction to Quality Control), JUSE, 1st ed. 1954; 2nd ed., 1964, 2nd ed., 1966, 3rd ed., 1989
[English] **Introduction to Quality Control** (3rd Edition), 3A Corporation, 1989

With Prof. Kaoru Ishikawa, EOQC Conference Amsterdam, 1982

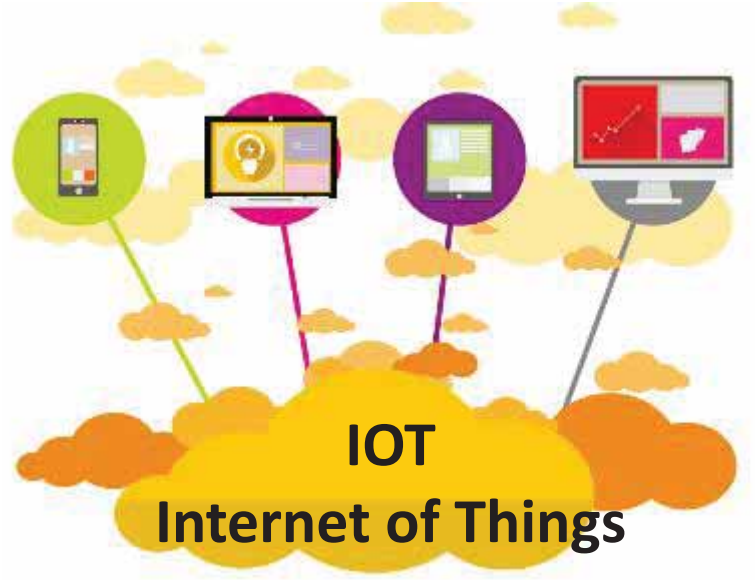
Contents

1. What Is IoT?

What Is IoT?

The Internet of things (IoT) is the inter-networking of physical devices, vehicles , buildings, and other items—embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data.

The IoT allows objects to be sensed or controlled remotely across existing network infrastructure.



https://en.wikipedia.org/wiki/Internet_of_things

Under IoT, we ubiquitously utilize ICT.

Ubiquitous: existing everywhere at any time

We can switch on and off room lamp at our house from our smartphone when we are outside of the home. In the society with IoT. this means that there is a connect between things embedded with electronics, software, sensors, actuators, and network connectivity. # Ken Sakamura(2016) “What Is IoT?”, Kadokawa Shoten

Big Data Analysis:

IoT brings about big data and then we need to make its analysis.

Open IoT vs Close IoT:

Open IoT is participated and used by anybody under a certain protocol . => Road Traffic *Best efforts*

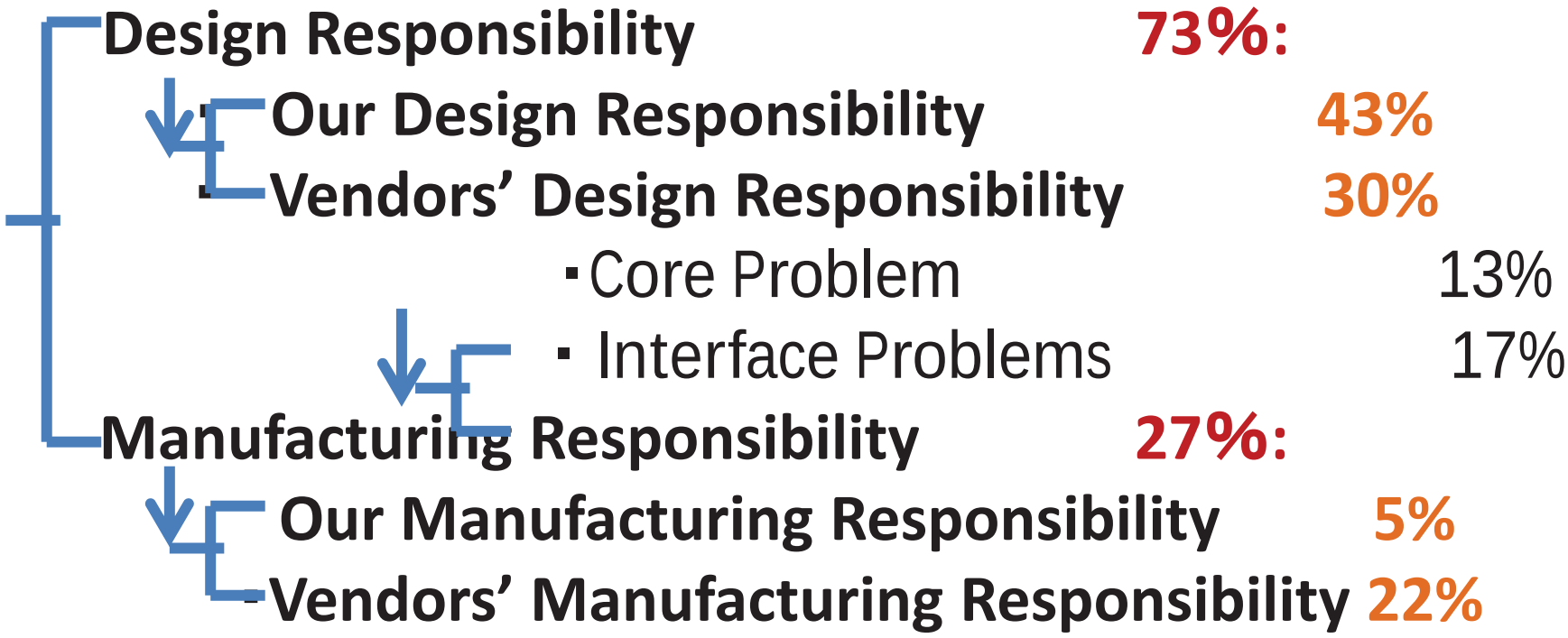
Close IoT is participated and used by a certain group of people.
=> Railway Traffice *Guarantee system*

Almost all the data related to Quality Assurance is confidential to outside of a company, Therefore, Intranet, namely, close IoT, is used.

2. What kinds of data are handled in Quality Assurance?

2.1. Example: Warranty Claim Data in A Mechanical Company in Japan

Warranty Claim Data by Ownership

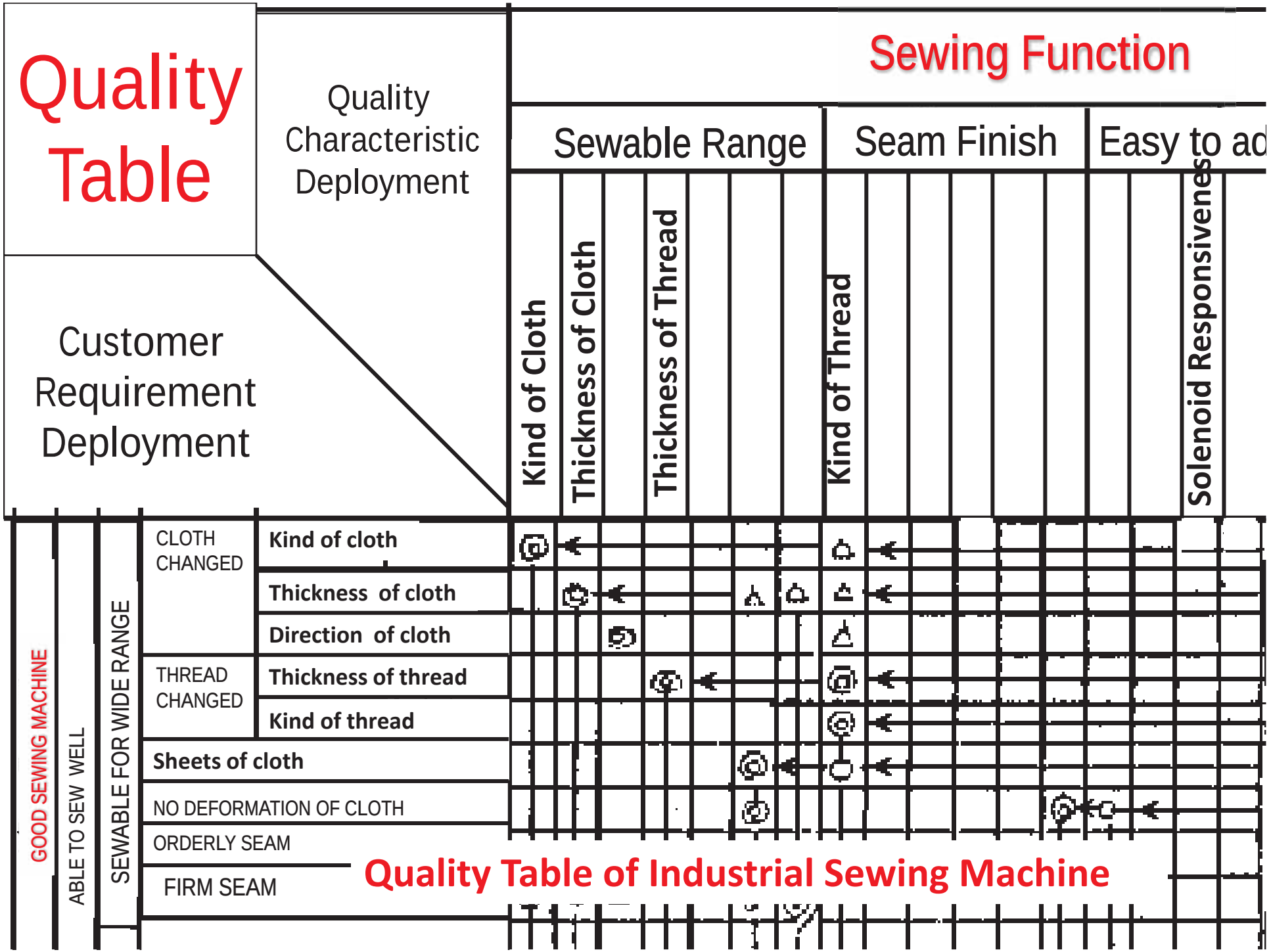


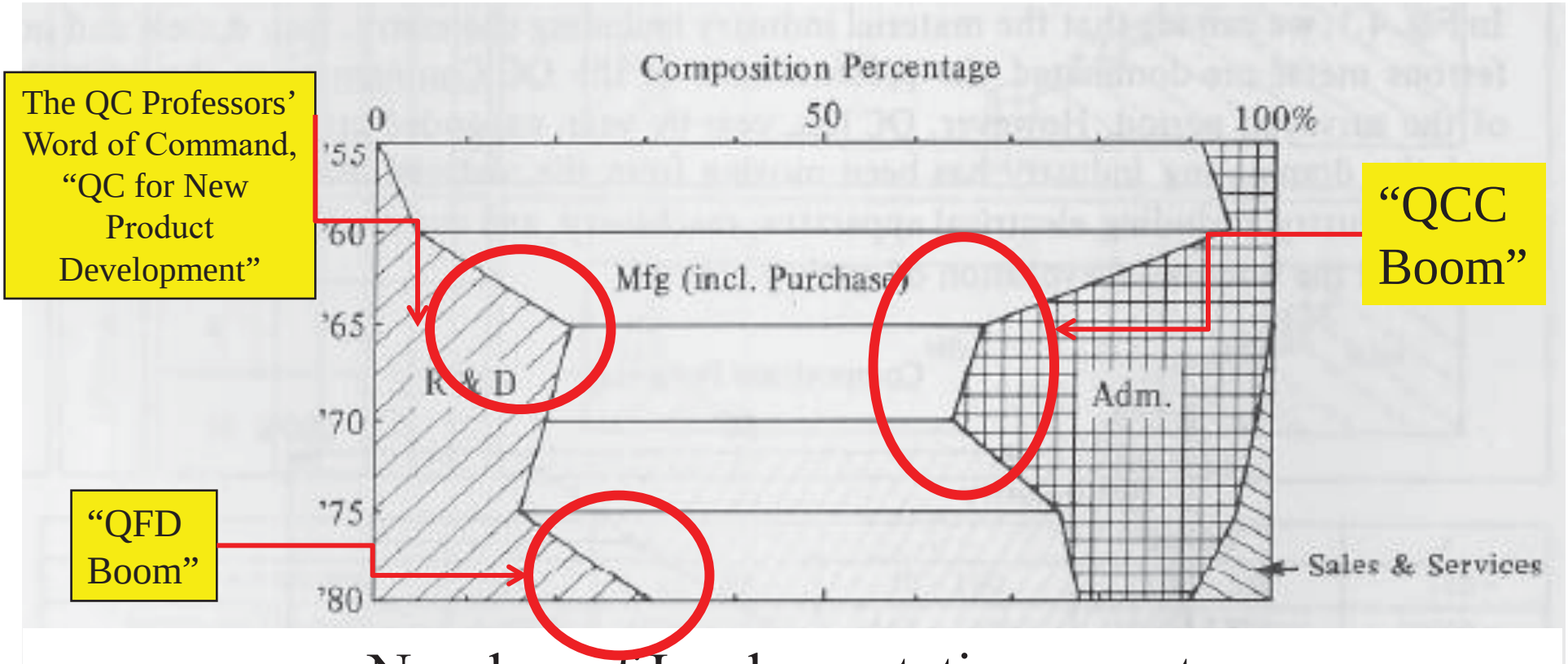
We need to investigate the warranty claims due to the responsibility of both of design and manufacturing

Warranty claim data consists of big data including 5W1H, reasons of outflow to the market, processes not detecting, the list of vendors to work for its components, the list of workers involved in operation, the reasons of making the symptom, the list of engineers involved in its R&D, and so on of each warranty claim.

2.2. Data for Quality Assurance in R&D

Application of QFD


Quality Table
Quality Characteristic Deployment
Customer Requirement Deployment
Sewing Function
Sewable Range
Seam Finish
Easy to ad
Kind of Cloth
Thickness of Cloth
Thickness of Thread
Kind of Thread
Solenoid Responsiveness
GOOD SEWING MACHINE
ABLE TO SEW WELL
SEWABLE FOR WIDE RANGE
CLOTH CHANGED
Kind of cloth
Thickness of cloth
Direction of cloth
THREAD CHANGED
Thickness of thread
Kind of thread
Sheets of cloth
NO DEFORMATION OF CLOTH
ORDERLY SEAM
FIRM SEAM
Quality Table of Industrial Sewing Machine



Number of Implementation reports
in the JUSE QC conferences
by functions such as
R&D, Manufacturing including Purchase,
Administration, and Sales and Services

Kano, N.（1984）"Evolution of Quality Control with Change of Economic Structure in Japan"
Report of Statistical Applications Research, JUSE , Vol. 31, No. 3, pp.22-41

Disincentive for dissemination of Quality Table:

Paper size problem: *We need on tatami length to list up all the customer requirements for one product*

Length of a *Tatami: about 180 cm*

21st Century Will Be
An Age of Full-Fledged Application of QFD

QFD is a method to handle so big soft data (language data) which needs big size of paper and frequent data insertion / deletion are necessary so that this does not continue to disseminate more.

However, by the remarkable progress of ICT specially with use of Excel, we have been released from the limitation of the paper size such as A4, or, A3.

Application of Excel will mitigate the manpower to prepare and brush up Quality Table.

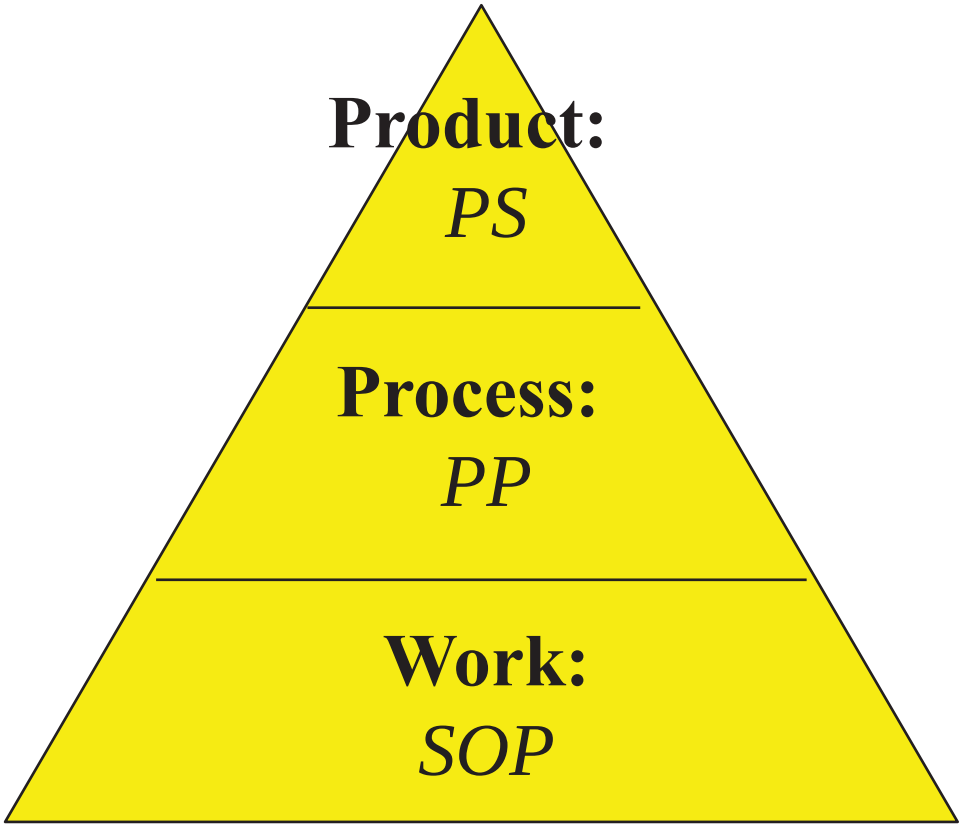
Quality Table by itself consists of big data.

2.3. Data for Quality Assurance in Manufacturing

Application of QA Matrix

Hierarchical Structure of In-Process Control

Three Tiers



PS: Product Specifications
PP: Process Parameters
SOP: Standard Operating Procedure

Example: QA Matrix of an Electronics Component Production Plant

Process Parameters / Product Spec's / Spec items		Process	material		1st Inner layer							1st Inner Lamination					1st Inner Plating	
		Control Parameter	KK thickness	MM thickness	PP1-1	PP1-2	PP1-3	PP1-4	PP1-5	PP1-6	AOI	PP2-1	PP2-2	PP2-3	PP2-4	PP2-5	PPK-3	copper plating program
		control range	33.5+/-5um	10mil +1-/1	28+/-5um	35+/-8u"	P5H-1038	22+/-5 step	<=40 um	3.8+/-0.3 m/min	run card	PM-38B(X) 10RDCOO%	30-55"	0.27~0.37 mg/cm2	PP_35 KG	<3℃	10~20u'	QC Plan
		Frequency range	IQC	IQC	each lot	each shift	each shift	each shift	each shift	each shift	IQC	IQC	each shift	2 hrs.	each lot	each shift	each lot	one time/day
Spec's of the Component	inner layer line width	100um+/-20%	○		◎	○	○	○		◎	△		○					
	outer layer line width	92um+/-20%																
	total board thickness (Au-Au)	1.2+/-0.1mm	○	◎								◎	△		◎	◎	-	
	dielectric thickness	L2~3=L6~7:75+/-15um										◎			◎	◎		
	surface Copper thickness	L3~L6:35+/-7.5um	◎			△							△					
		L1/L8:44+/-10um																
SOP			SOP of material		SOP of 1st Inner layer							SOP of 1st Inner Lamination					SOP of 1st Inner Plating	

21st Century Will Be An Age of Thorough Application of BQiP

＊ BQiP: Build Quality in Process

The QA Matrix consists of product specifications as row and process parameters in columns. It is not so rare to find that the number of specifications for one product is over one hundred and the number of process parameters is over one thousand. The number of data handled on the matrix is so big that, if we would not have been released from the limitation of the paper size such as A4, or, A3, it could not be prepared. This has become possible only with Excel and today's advanced ICT. It would not be in the 20th century but only in the 21st century.

Therefore, if we intend to thoroughly BQiP, we need to prepare QA matrix and thoroughly control each of process parameters along with its ranged area faithfully along with SOP.

3. Intranet of Qualities (IoQ) as Comprehensive Network for Quality Assurance in the Digital Era

For Quality Assurance,

let's develop IoT to link various data of Qualities

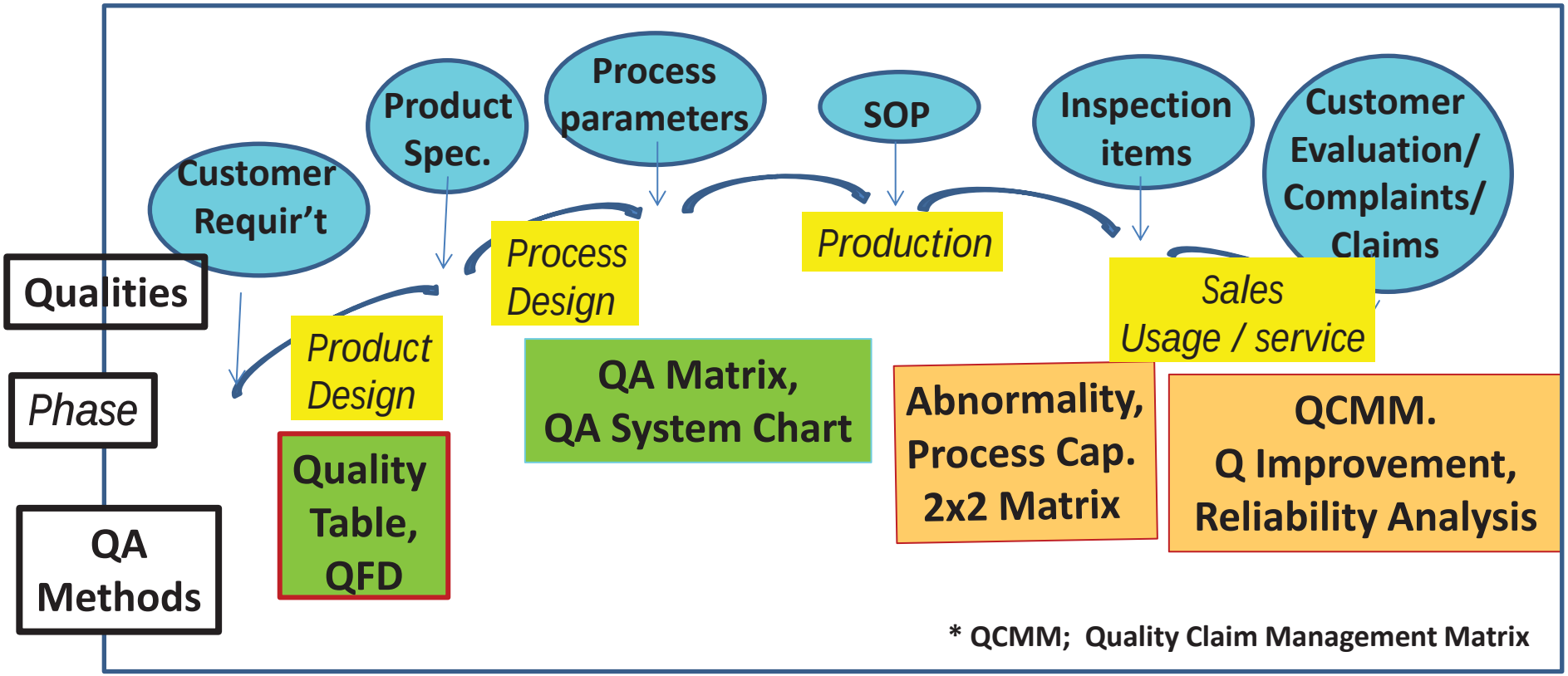
shown as examples in the below

so as to identify their trend and analyze their relations

on real time basis.

- Customer Requirements
  (Quality Elements)
- Product Specifications
- Component Specifications
- Process Parameters
- SOP
- Testing Characteristics
- Inspection Items
- Customer Evaluation/Complaints/Claims
- Etc.

IoQ: Intranet of Qualities



What Is IoQ?

The Intranet of qualities (IoQ) is the intra-networking of phases, qualities, and QA methods that enable these objects to collect and exchange data.

IoQ consists of:

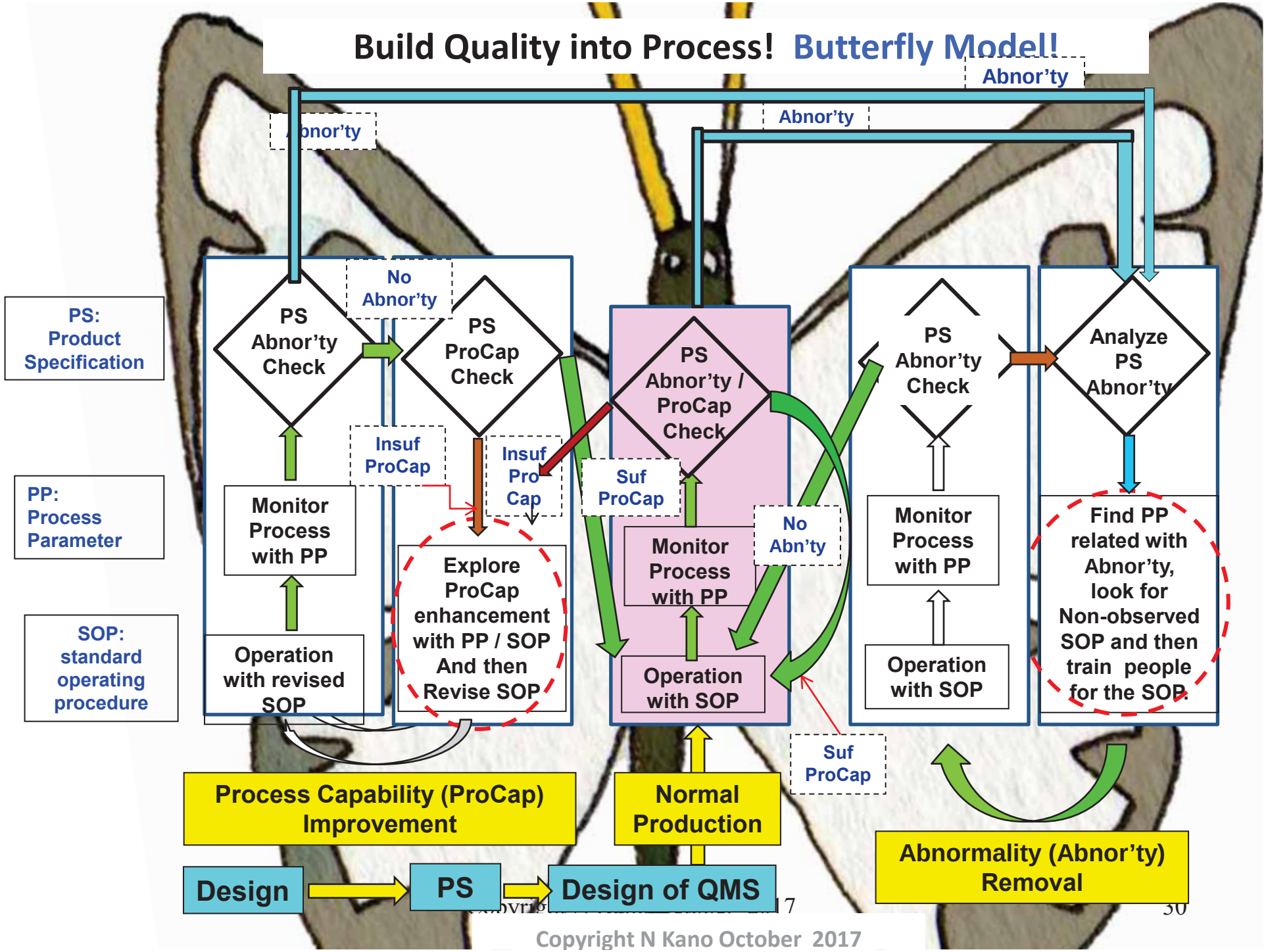
- **the phases** such as product design, process design, production, inspection, sales and usage service:
- **the qualities** such as quality requirements, product specifications, process parameters, SOP, inspection data, and customer evaluation
- **QA methods** such as quality table, QA matrix, QA system chart, abnormality vs process capability, 2x2 matrix, QCMM, quality Improvement and reliability analysis

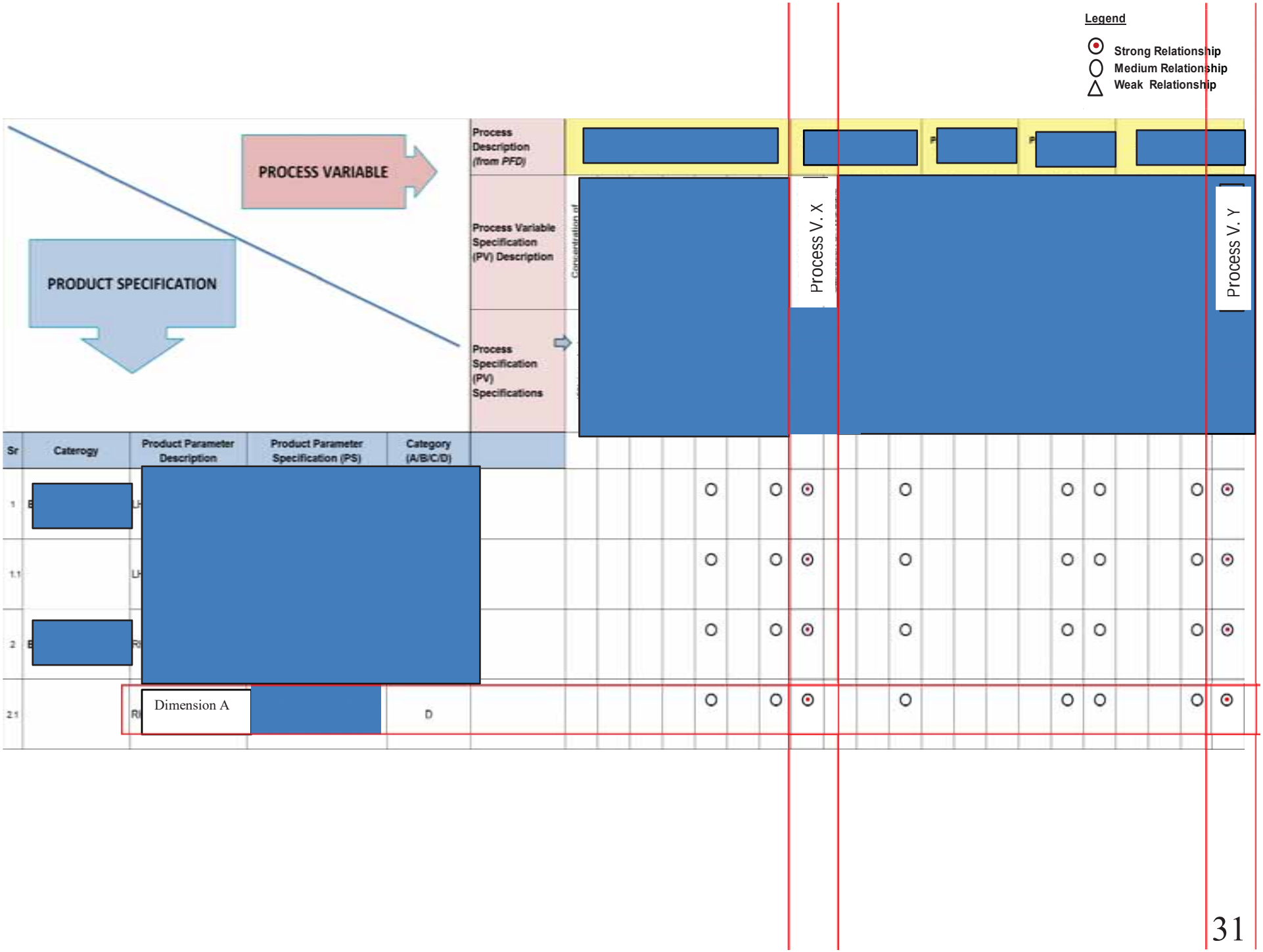
IoQ is a closed system within an organization but not open like IoT.

In this presentation, we discuss
some of the key elements of IoQ for QA in the IoT age

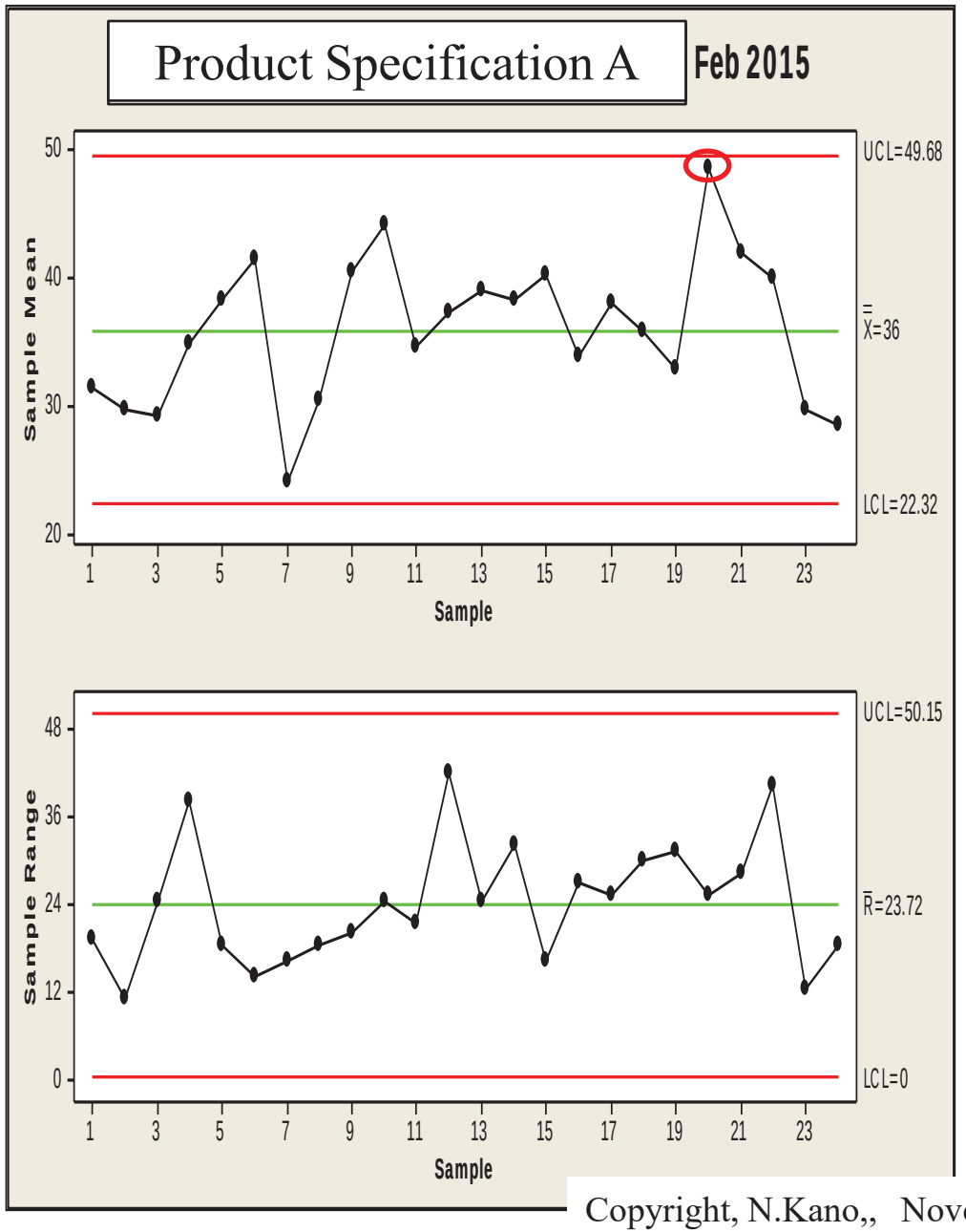
4. Application of IoQ
and
Some Remarks
for Use of Big Data

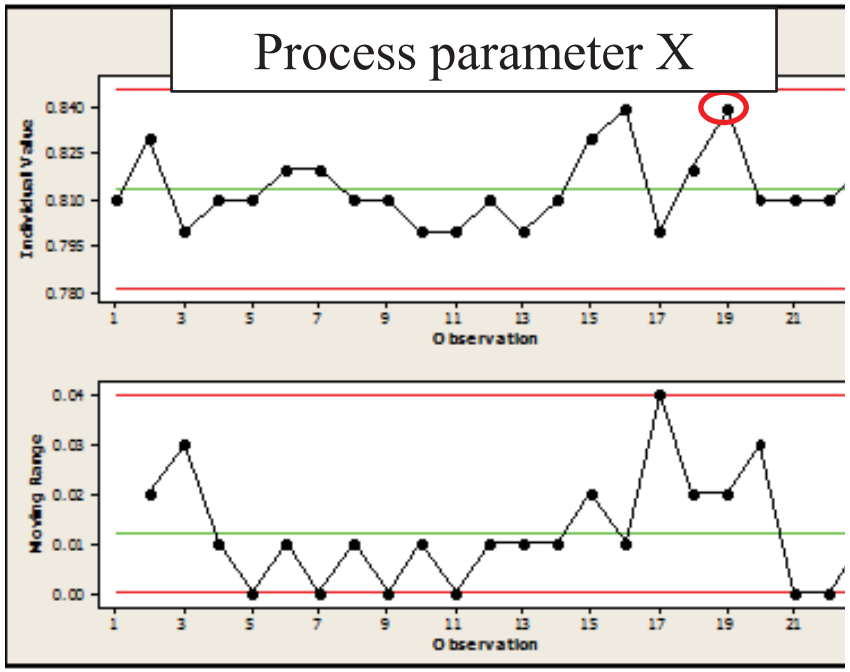
Build Quality into Process! Butterfly Model!

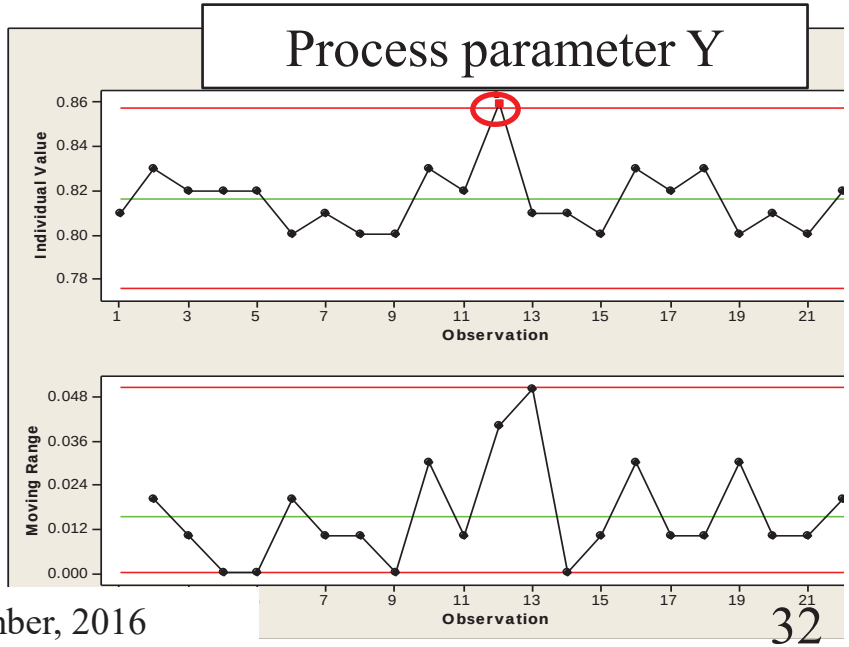



Legend
Strong Relationship
Medium Relationship
Weak Relationship
PROCESS VARIABLE
PRODUCT SPECIFICATION
Process Description (from PFD)
Process Variable Specification (PV) Description
Process Specification (PV) Specifications
Process V. X
Process V. Y
Sr
Caterogy
Product Parameter Description
Product Parameter Specification (PS)
Category (A/B/C/D)
Dimension A
D

Product Specification vs Process parmeters in Stability

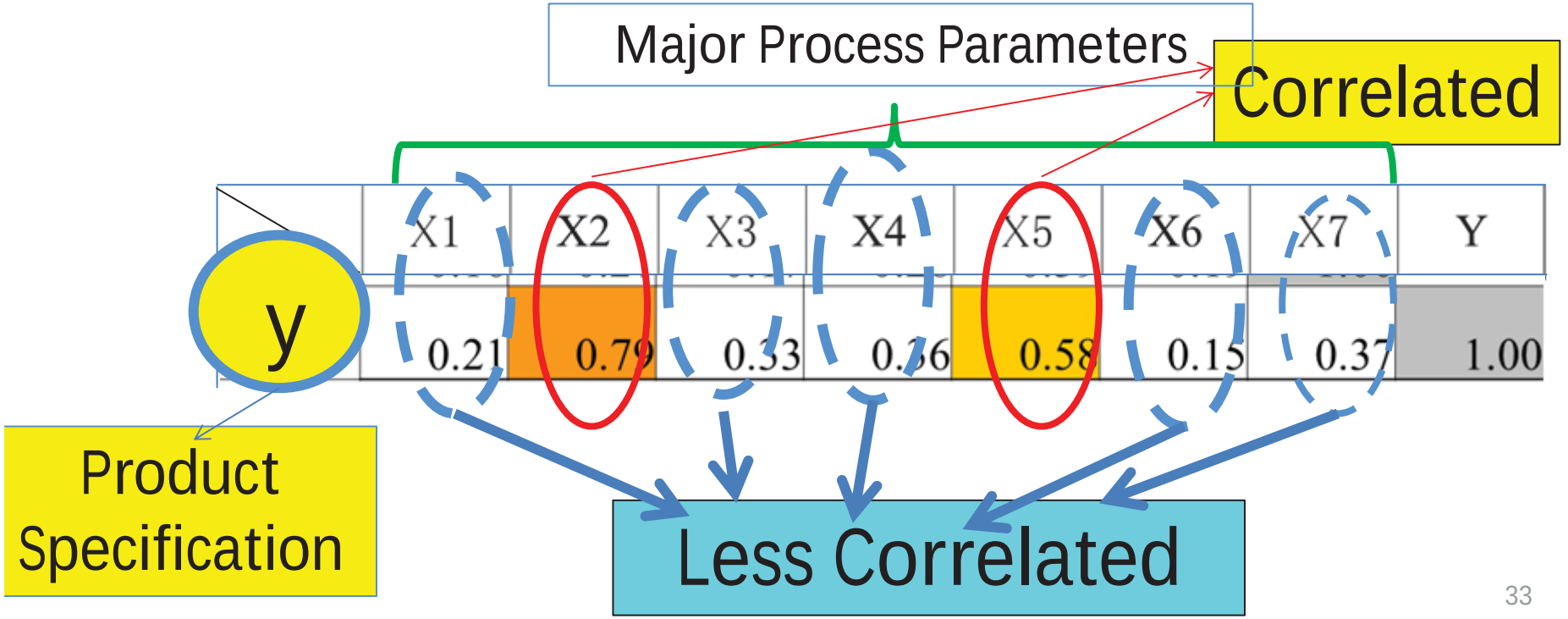






Question to Everybody!

Is a major process parameter, whose data are collected in a production process, correlated with the product specification ?
"Yes, Correlated" or "No, Less Correlated"?

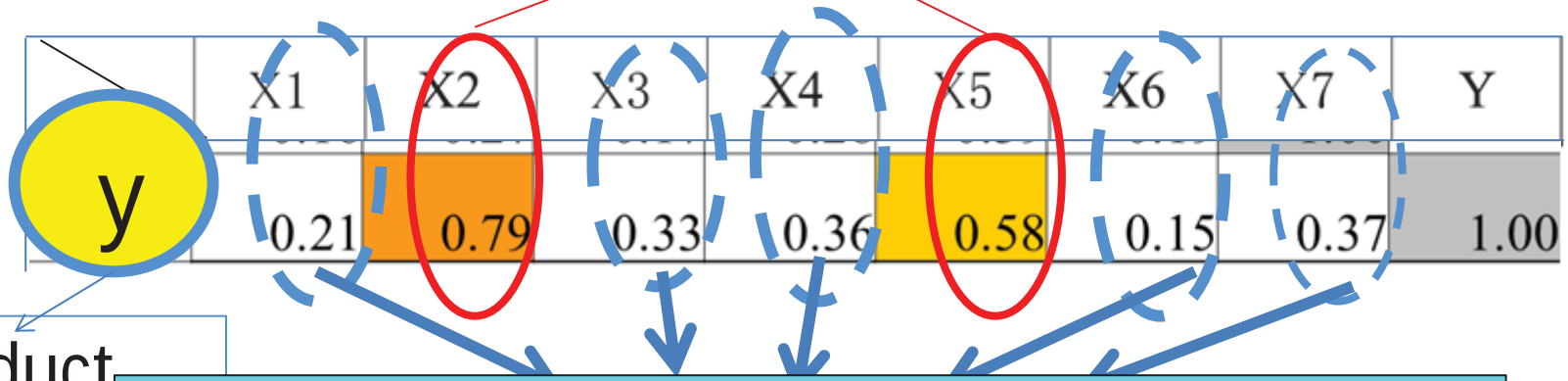


Answer to Question to Everybody!

Is a major process parameter, whose data are collected in a production process, correlated with the

"No, Less Correlated"

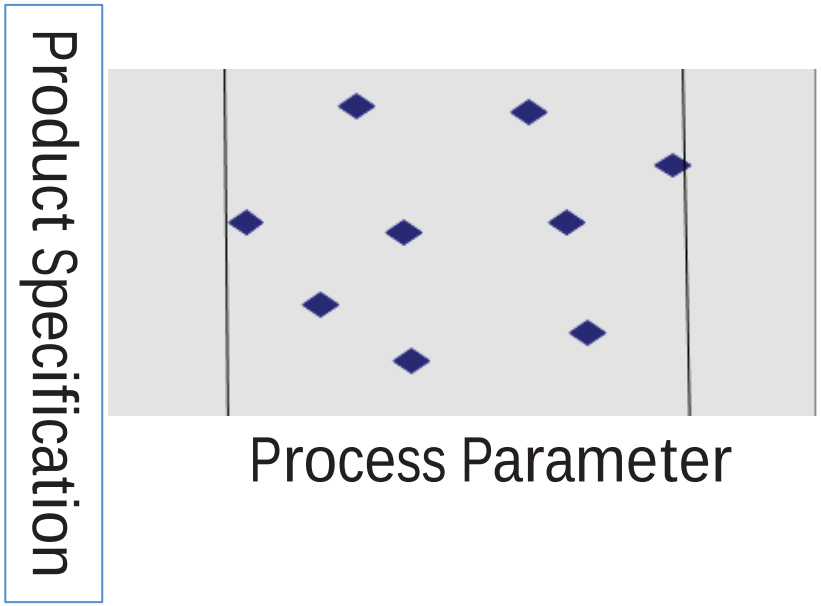
Correlated⇒Poorly Standardized or SOP Is Not Observed



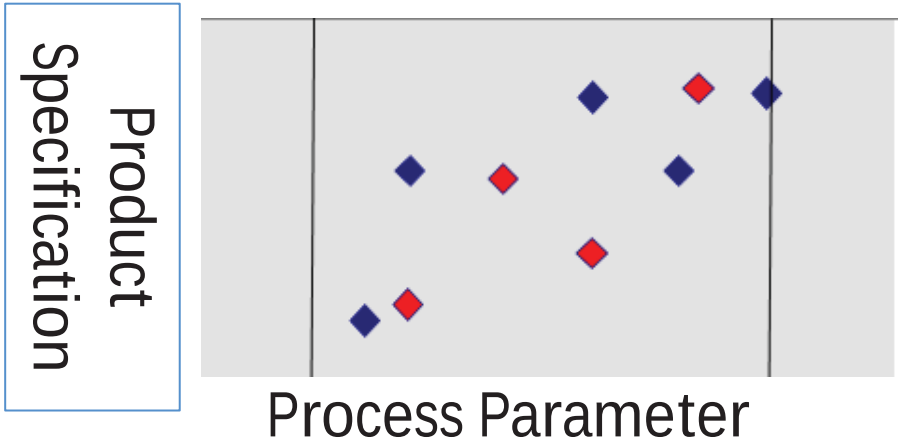
Product Specificati

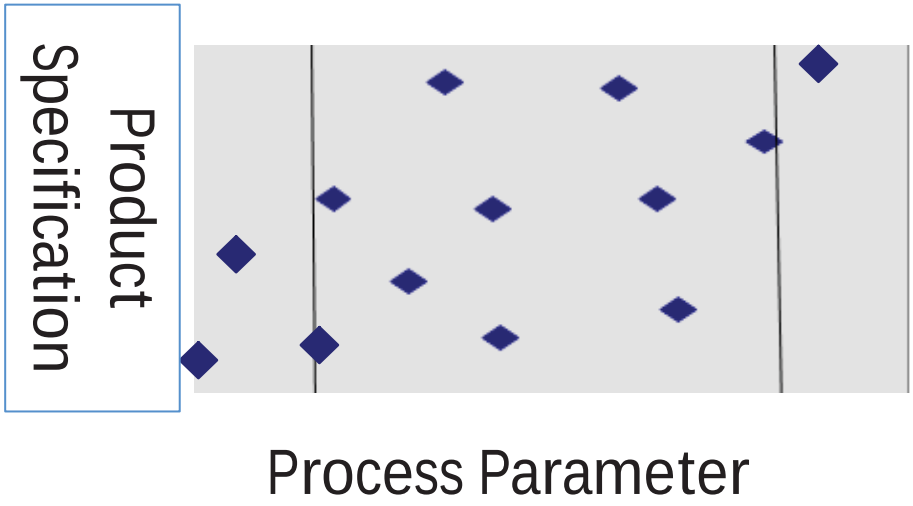
Less Correlated⇒Well Standardized and SOP Is Observed

Less Correlated
Well Standardized and SOP Is Observed



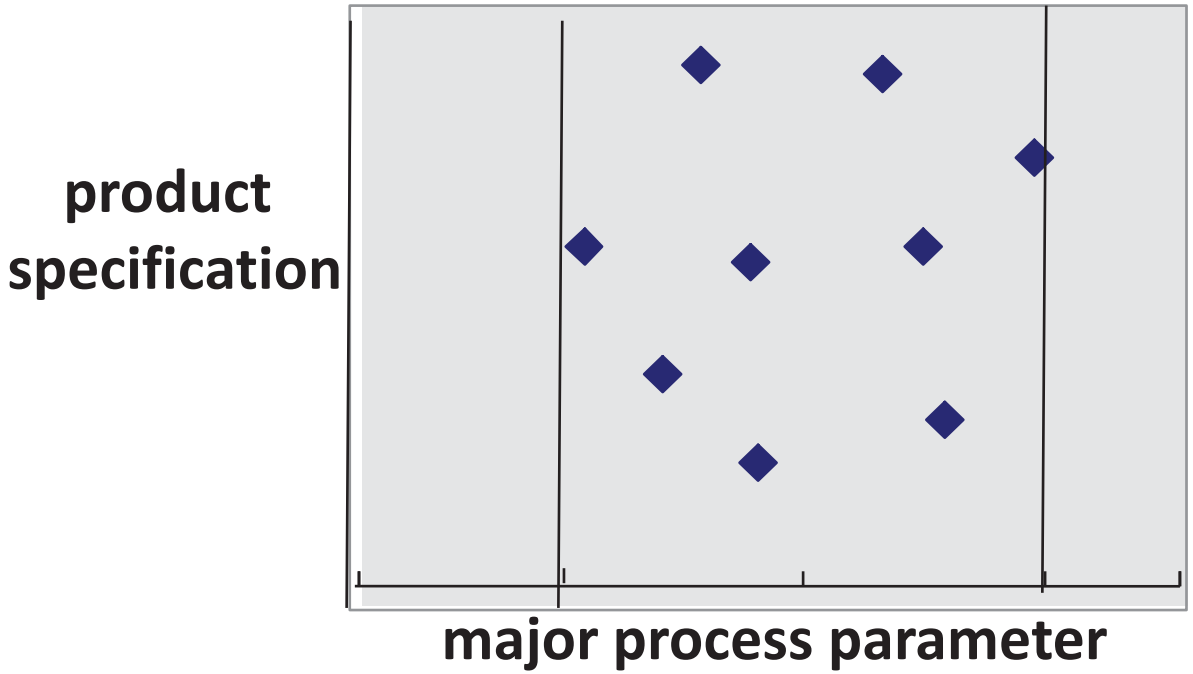
Correlated
Poorly Standardized or SOP Is Not Observed





What Is the Uniqueness of the Data from Production Process?

It is standardized. It means that
the variation range of major process parameters
Is made narrow enough for them
so as to be less correlated with product specification.

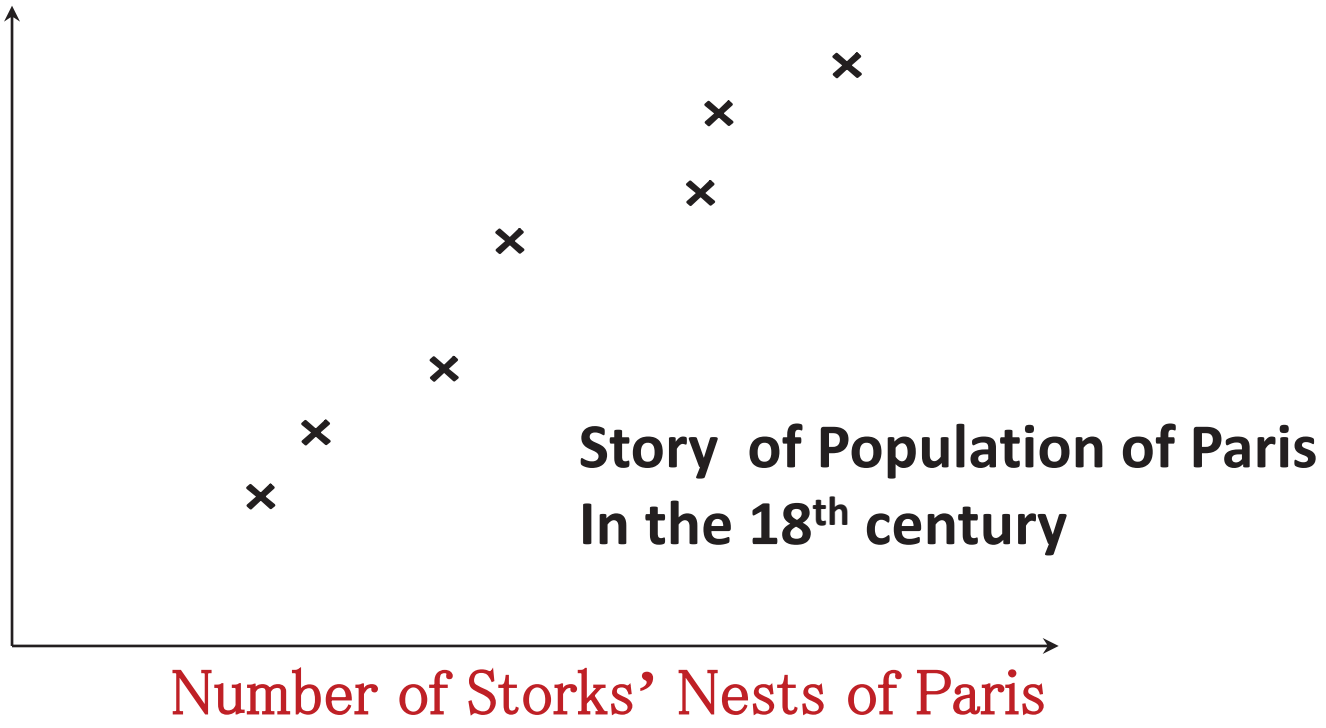


Incidentally,
Remarks for Using Correlation

“Mama! How Is A Baby Born?”

“A Stork Carries It!”

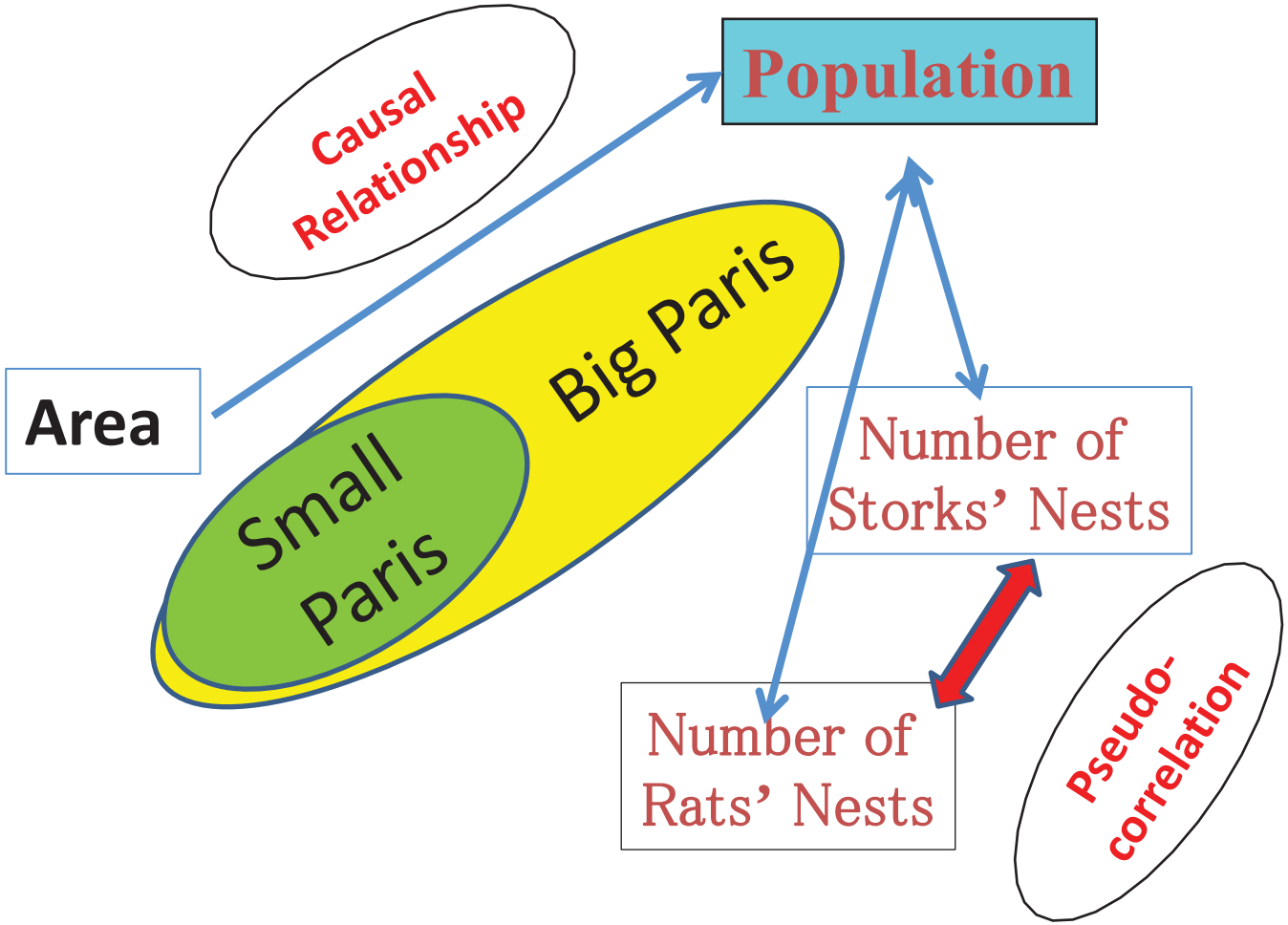
A Statistician proved this by showing the scatter diagram on the right side.



Noriaki Kano learned the above anecdote in a class of Prof. Shigeichi Moriguchi when Kano was a graduate student in the University of Tokyo (UT) during 1964-66. Later Dr. Kano had an opportunity to talk with Prof. Moriguchi on the road in the campus of the University of Electro-communications around the late 1970s where Prof. Moriguchi moved after retiring from UT that Dr. Moribuchi learned this from Prof. Hotteling in his class at North Carolina University when Prof. Moriguchi stayed there 1950-52..

“Mama! How Is A Baby Born?”

“A Stork Carries It!”



Story of Area Expansion of Paris In the 18th Century

Among social data (non-standardized data)
we may find
correlation!

In this case we must be careful that
correlation
does not necessarily mean
causal relation.

Forget the illusion that
we can handle all types of data
on the internet?

Today, the data we can handle on the Internet
is limited to the data of:
visual and auditory senses
but not any data of:
taste, smell and touch senses.

*** Visual data: lack of sense of dimension**

Thank you!

Arigato-Ohkini-Dandan-XieXie-Dosha-Ganxie-Xiaja-Shale-

Bayarlalaa-MahaloNui-Gamsahamnida-Komapsumnida-Terimakasih- salamat -CamOn -KobKunKrub-Chiztinbate - Kaadinchhey La- ka lawm e-Dhanyavad- Dhanyabedam! - Nandri- Dev Borem Korum-Nanni-Abhar-Aabhari Ahe-Stutiyi– Dhanyabaad- Raxmat -Shukria-Mamnoon-SepasGozaram-Motshakeram-Toda-Shukran-AsanteSana-NaGode-Me daa si-TeshekkurEderim-Efharisto-Grazie-Grazzi-Grazie-Gracias-Obrigado-Merci-Danke-DankU-Tack-Kitos-Dankie-Thank You-Jinkua-Go Raibh Maith Agat-Spasibo-Ačiū-Aitäh-Paldies-

KoeSoeNoem- Blagodaram-благодаря (blagodarya) –Kosti-Multumesc-Multzumesc -Dziekuje-Dekuji-Akwaaba

(65 languages , as of 2016/05)

Do you know which country or which language each of these expressions come from?
If you know more than 10 languages, your level of international knowledge is quite high.