國立雲林科技大學工業工程與管理所
Graduate school of Industrial Engineering & Management,
National Yunlin University of Science & Technology

系統可靠度實驗室 System Reliability Lab.
http://campusweb.yuntech.edu.tw/~qre/index.htm

The Application of the Six Sigma Concept to Port Security Process Quality Control

出處：Quality and Reliability Engineering International

作者：S.-T. Ung, S. Bonsall, V. Williams, A. Wall and J. Wang

老師：童超塵 教授

報告者：卓益如

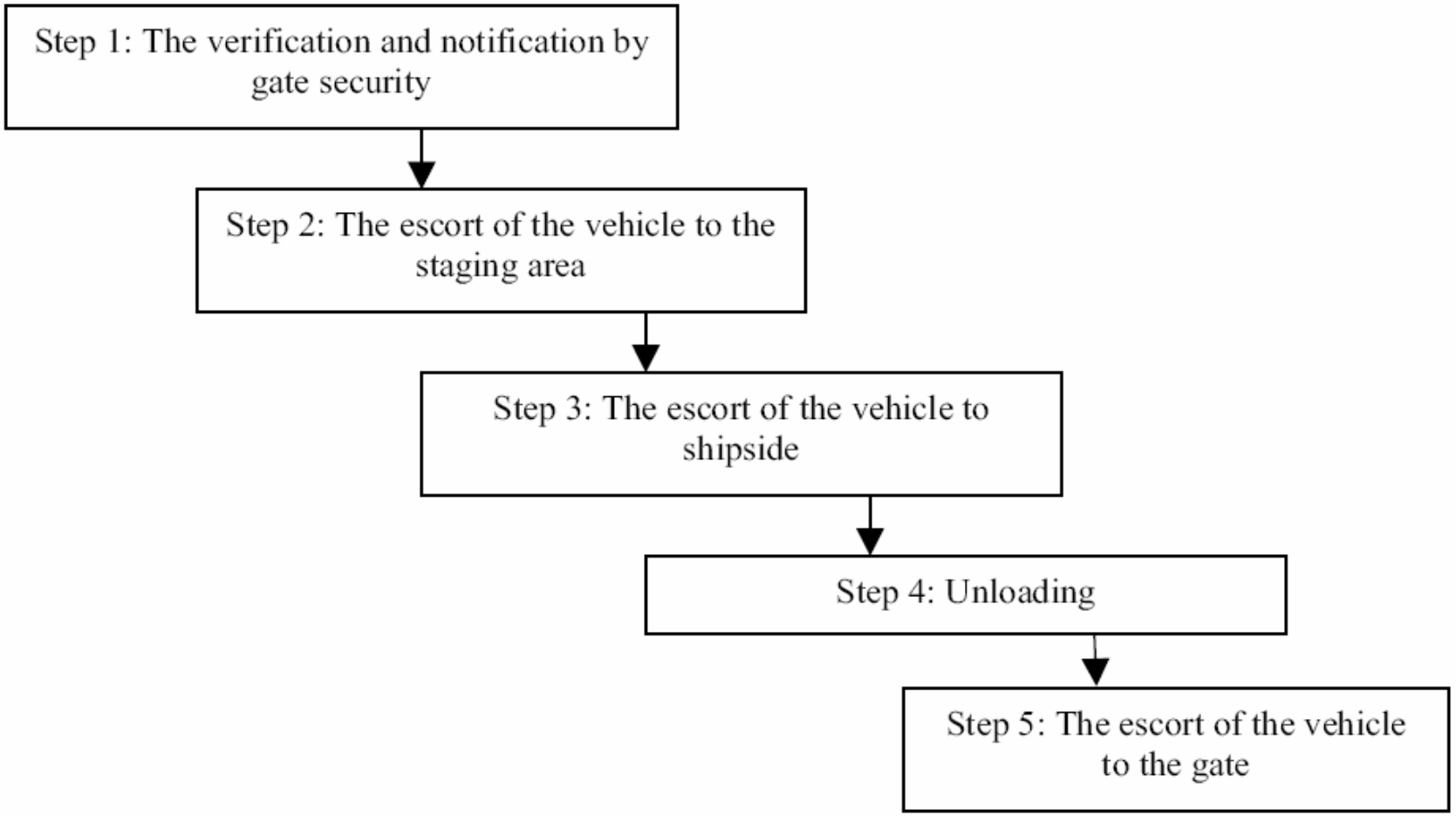
Introduce

- After 911 in 2001,more attention is paid to maritime since the terrorist attack in the U.S.A. , International Maritime Organization (IMO) adopted the ISPS Code.
- The aim of this paper is to demonstrate that the work mentioned above can be completed by applying the Six Sigma concept to port security through a test case based on expert judgement.

The application of Six Sigma methodology

- The Six Sigma methodology includes five steps：
- Definition of the measuring unit
- Measurement of the current process performance
- Analysis of the root cause and identification of the solutions
- Improvement of process quality
- Control of the process quality

The security process of ship stores transport



The definition of time

- Step1: time of verifying the vehicle and driver details and the notification of the SSO
- Step2:the time spent when escorting the vehicle to the designated staging area and waiting for the permit for delivery
- Step3:the period of escorting the vehicle to shipside
- Step4:the unloading time
- Step5:the time required to escort the vehicle to the gate

The application to the security process

- In this case, the type of ship stores transported is only focused on foodstuff.

  (1) The identification of CTQ

  - It’s a firm and measurable satisfaction indicating the USL and LSL of the quality translated.
  - It’s assumed that the CTQ is 50 mins, meaning that the time limit requested by the traders organizing the foodstuff supply takes no longer than 50 mins.

(2)Define

- The sample number is assumed to be 100.
- The frequency of measuring the mission time of the security process is 100.

(3)Measure

- Table.1 shows the mean(μ) and standard deviation(σ) in each step.
- Fig.2 illustrate the time distribution of each security process.

- The process sigma metric for short term is calculated as follows:

$$Z_{USL} = \frac{(usl - \mu)}{\sigma} = \frac{(50 - 42.39)}{8.56} \cong 0.89$$

- since there is no LSL in this case study, the probability that the process performance is outside the LSL,$P(Z_{LSL})$, is set to zero.

$$P(Z_{satisfied}) = P(Z_{USL}) - P(Z_{LSL}) = 0.8133 - 0 = 0.8133$$

$$P(Z_{defect}) = 1 - P(Z_{satisfied}) = 1 - 0.8133 = 0.1867$$

$$DPMO = 1000000 \times P(Z_{defect}) = 186700$$

(4)Analyse

- In this case, the Analyze step is omitted. In reality, if the quality of a security process was unacceptable, the problem would have originated from step1 and 2.
- The decision maker can realize now the distribution by sensitivity analysis by altering the value of the means in step 1 and 2 and standard deviations in all steps.

Sensitivity analysis 1：

- Altering Mean: step1：8 → 6

  step2：14 →12

Comparison between Tables Ⅰ and Ⅱ

The quality improvement is acquired as follows：

$$PSM_i = PSM_{improved} - PSM_{original}$$

$$= 3.14 - 2.4 = 0.74$$

Sensitivity analysis 2：

- Altering standard deviation:

step1: 3.0 → 1.5 ；step2: 6.5 →3.0

step3: 2.0 → 1.5 ；step5: 1.5 →1.0

Comparison between Tables Ⅰ and Ⅲ

$PSM_i = PSM_{improved} - PSM_{original}$

$= 3.19 - 2.4 = 0.79$

Sensitivity analysis 3：

- Altering the values as shown in table Ⅳ
- Fig.5 is much focused and centred to the mean than fig.2.

$PSM_i = PSM_{improved} - PSM_{original}$

$= 4.27 - 2.4 = 1.87$

Table IV. Sensitivity analysis 3 (in minutes)

	Mean (μ)	Standard deviation (σ)
Step 1	6	1.5
Step 2	12	3.0
Step 3	5	1.5
Step 4	10	2.0
Step 5	5	1.0
The whole process	38.07	4.31

Conclusion of sensitivity analysis

- The values of sensitivity analysis 3 is 1.87, sensitivity analysis 3 is preferred to the others.
- Sensitivity analysis 1 could mean allocating the resource available to employ, recruit or move staff from other departments without training.
- Sensitivity analysis 2 suggests providing the training scheme without placing any additional personnel.

(4)Improve

- The purpose of this step is to have the solution implemented in the security process and to reduce the variation in order to provide customer satisfaction.

(5)Control

- The actual quality improvement in the process can be obtained by providing solutions such as organizing a periodical training scheme as to quality.

The deployment of the port personnel to implement six sigma

- Champions :Directors of operations, finance, personnel and Marketing
- Master ：Senior managers of safety, security, terminals and marine groups within operations
- Black Belt：The managers of the container, bulk, oil and roll on/roll off (RO/RO) terminals plus say pilot manager
- Green Belt： Shift managers of container, bulk, oil or RO/RO terminals or contractors working on these terminals

Conclusion

- In this paper the authors have demonstrated how to improve the quality or port security measures by applying Six Sigma using time as a measuring index.
- If any port authority intends to apply Six Sigma to its quality of security or other operation process, the information and data from each stage must be carefully and quantitatively gathered.

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Table I. The mean and standard deviation in each step and the whole process (in minutes)

	Mean (μ)	Standard deviation (σ)
Step 1	8	3.0
Step 2	14	6.5
Step 3	5	2.0
Step 4	10	2.0
Step 5	5	1.5
The whole process	42.39	8.56

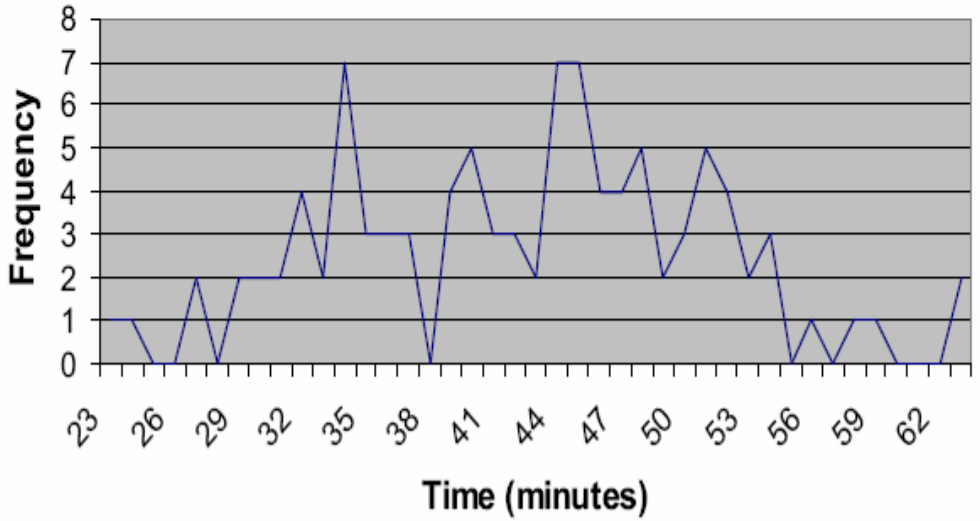

Figure 2. The time distribution of the current assumed security process

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	Mean (μ)	Standard deviation (σ)
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Step 4	10	2.0
Step 5	5	1.5
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R=40

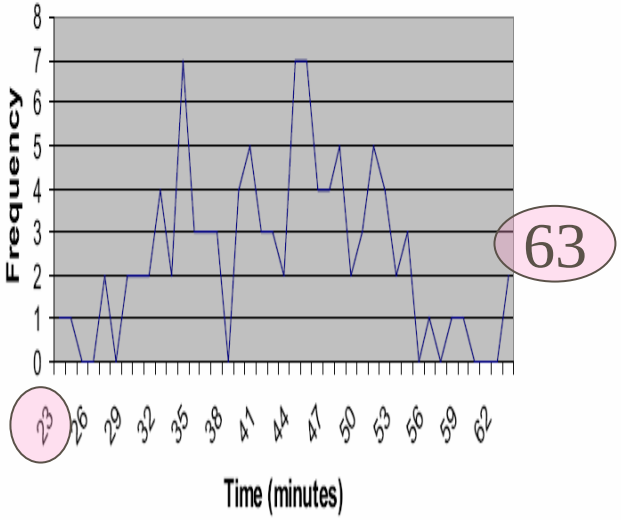

Figure 2. The time distribution of the current assumed security process

Table II. Sensitivity analysis 1 (in minutes)

	Mean (μ)	Standard deviation (σ)
Step 1	6	3.0
Step 2	12	6.5
Step 3	5	2.0
Step 4	10	2.0
Step 5	5	1.5
The whole process	38.23	7.16

R=36

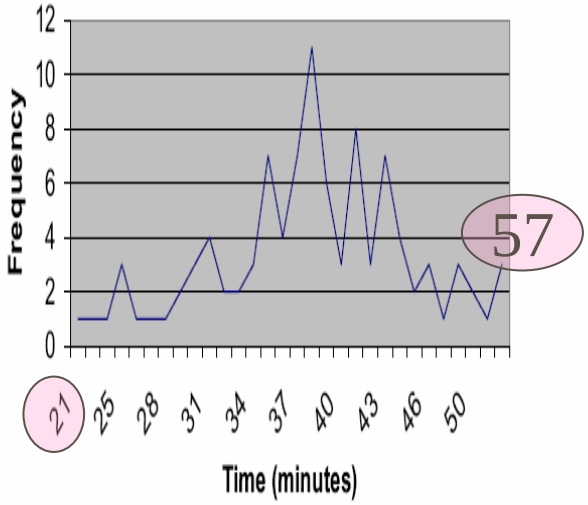

Figure 3. The time distribution of the improved security process by changing the mean

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	Mean (μ)	Standard deviation (σ)
Step 1	8	3.0
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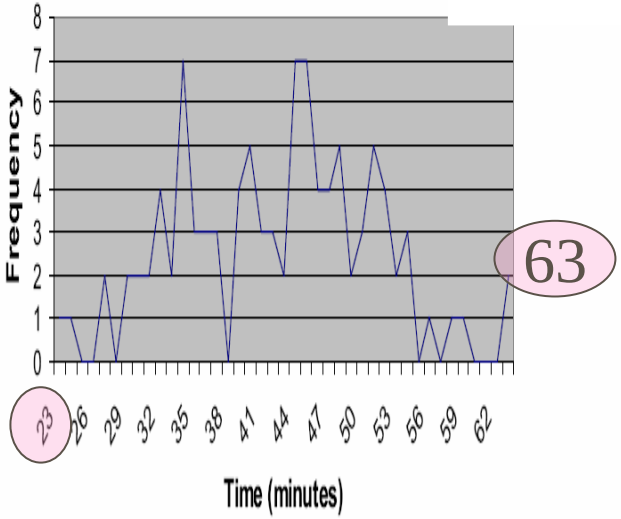


Figure 2. The time distribution of the current assumed security process

Table III. Sensitivity analysis 2 (in minutes)

	Mean (μ)	Standard deviation (σ)
Step 1	8	1.5
Step 2	14	3.0
Step 3	5	1.5
Step 4	10	2.0
Step 5	5	1.0
The whole process	42.86	4.28

R=21

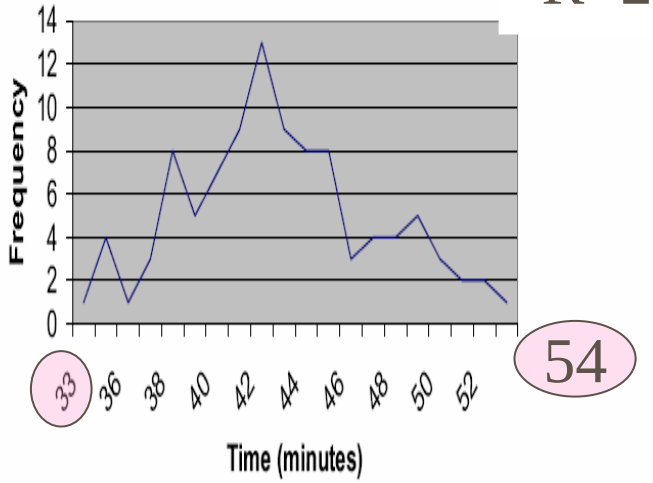
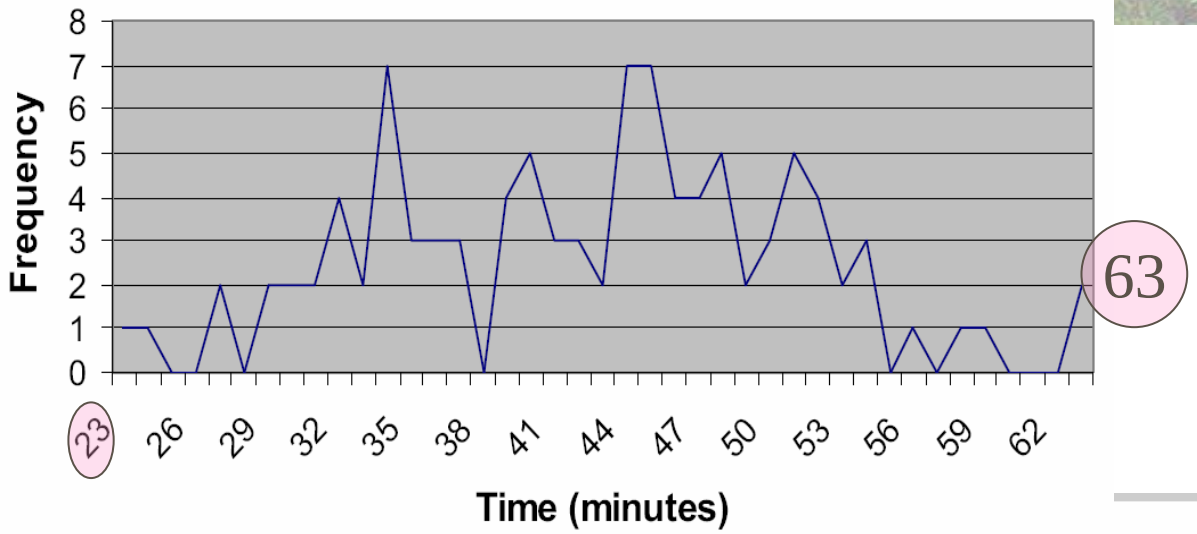
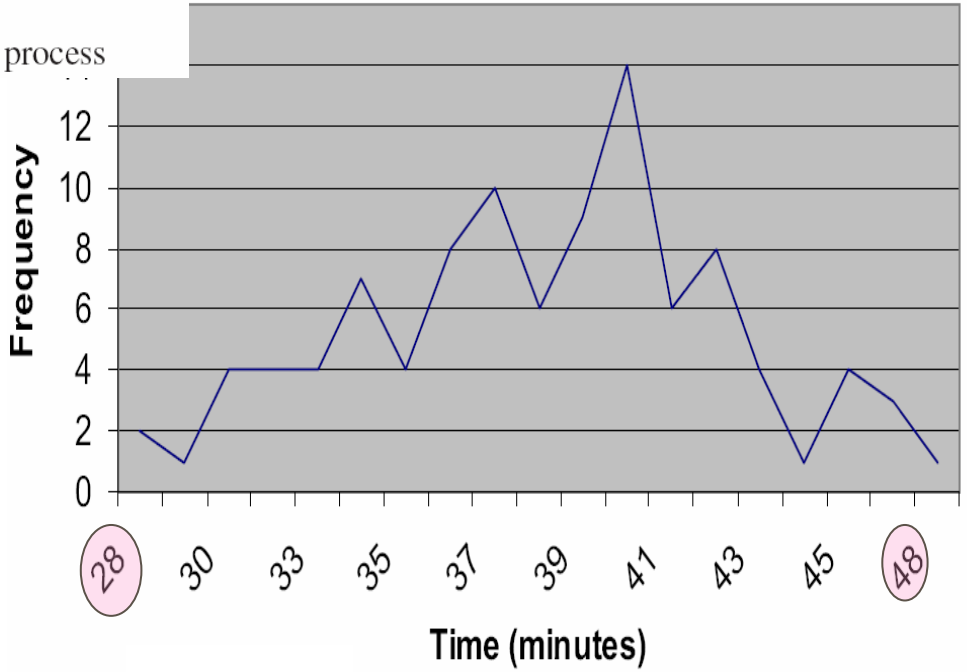


Figure 4. The time distribution of the improved security process by changing the standard deviation



R=40

Figure 2. The time distribution of the current assumed security process



R=20