Production workers' subjectifying work action and complex problem solving

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BIBB-Kongress 2022, 28.10.2022
Denkraum 2: Digitale Transformation gestalten / Thinking Space 2: Shaping digital transformation

http://www.bibb.de/kongress2022

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1. Background

- We were inspired by “the experiential knowledge” of German industrial sociology and Pfeiffer(2016)’s concept of ‘objectifying and subjectifying work action’.
- Research has taken place in the framework of a joint project between KRIVET and BIBB.
- As automation technology advances and job contents change, problem-solving is one of the most important skill requirements at the workplace.
- We have applied this concept to ‘complex problem solving’, surveyed ‘the subjectifying work activities’ of workers to solve complex problems, and empirically analyzed what factors influence subjectifying action of production workers.

2. Research Questions

In the process of solving problems

i) How does subjectifying action relate to workers' tenure and skill level?

ii) How does one's subjectifying action relate to objectifying action?

- Are there any complementarity and differences between engineers and production workers?

iii) How is subjectifying action affected by factors such as the nature of the tasks performed, the level of computer technology use and automated machines use?

3. Data and method

- Survey : 818 employees from SMEs in manufacturing in 2021.
  - Survey on Skill Requirements(SSR)
  - Two occupations: engineers (128), production workers* (690).

    * Machinery mechanics & fitters, Repairers, Operators, Process controllers, Assemblers.

- Complex Problems: Problems that require more than 30 minutes to find a solution, but do not include time to act. See PIAAC (2012)

- Measuring of "Subjectifying work action"
  1. asked 'how often do you face problems in work process? '
  2. asked workers to respond on a 3-point scale to the following activities for solving problems, and figured out the sum.

3. Pfeiffer(2016)'s concepts

Table 1. Dimensions of subjectifying and objectifying work action.

Usual Conceptions of Work "Objectifying"	Dimensions	and the Role of Experience "Subjectifying"
data registering	perception	holistic-sensory
planned out	process	dialogic and explorative
logical and analytical	thinking	sensing and associative
theory-based	knowledge	experience-based
objective and rational	relation	empathetic

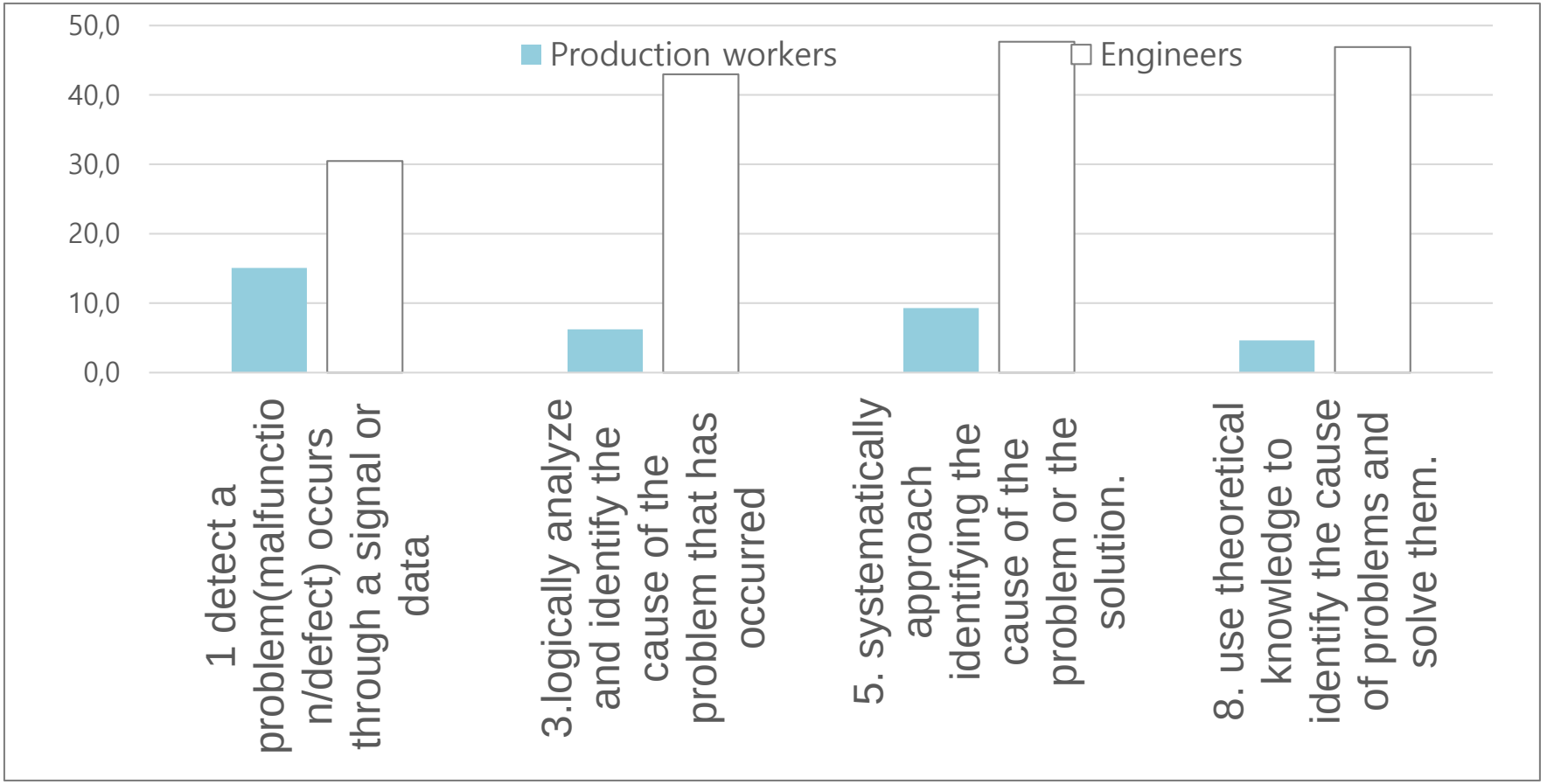
KRIVET Questionnaire

Q15. The following statements are about problems that you are facing at work and how you solve them. How often do you apply the mentioned methods in your job?

Categorize *	Methods for identifying and solving problems*	Never	Sometimes	Often
Objectifying	01. I detect whether a problem (malfunction/defect) occurs through a signal or data.	①	②	③
Subjectifying	02. I detect whether a problem (malfunction/defect) occurs with my physical sense. (Example: sniffing, listening closely, etc.)	①	②	③
Objectifying	03. I logically analyze and identify the cause of the problem that has occurred.	①	②	③
Subjectifying	04. I identify the cause of the problem that has occurred through intuition or momentary feeling.	①	②	③
Objectifying	05. I systematically approach identifying the cause of the problem or the solution.	①	②	③
Not used	06. I solve problems through conversations and discussion with others.	①	②	③
Subjectifying	07. I solve problems by exploring various alternatives or going through trial and error.	①	②	③
Objectifying	08. I use theoretical knowledge to identify the cause of problems and solve them.	①	②	③
Subjectifying	09. I use feelings gained through my own work experience to identify the cause of the problem and to solve it.	①	②	③

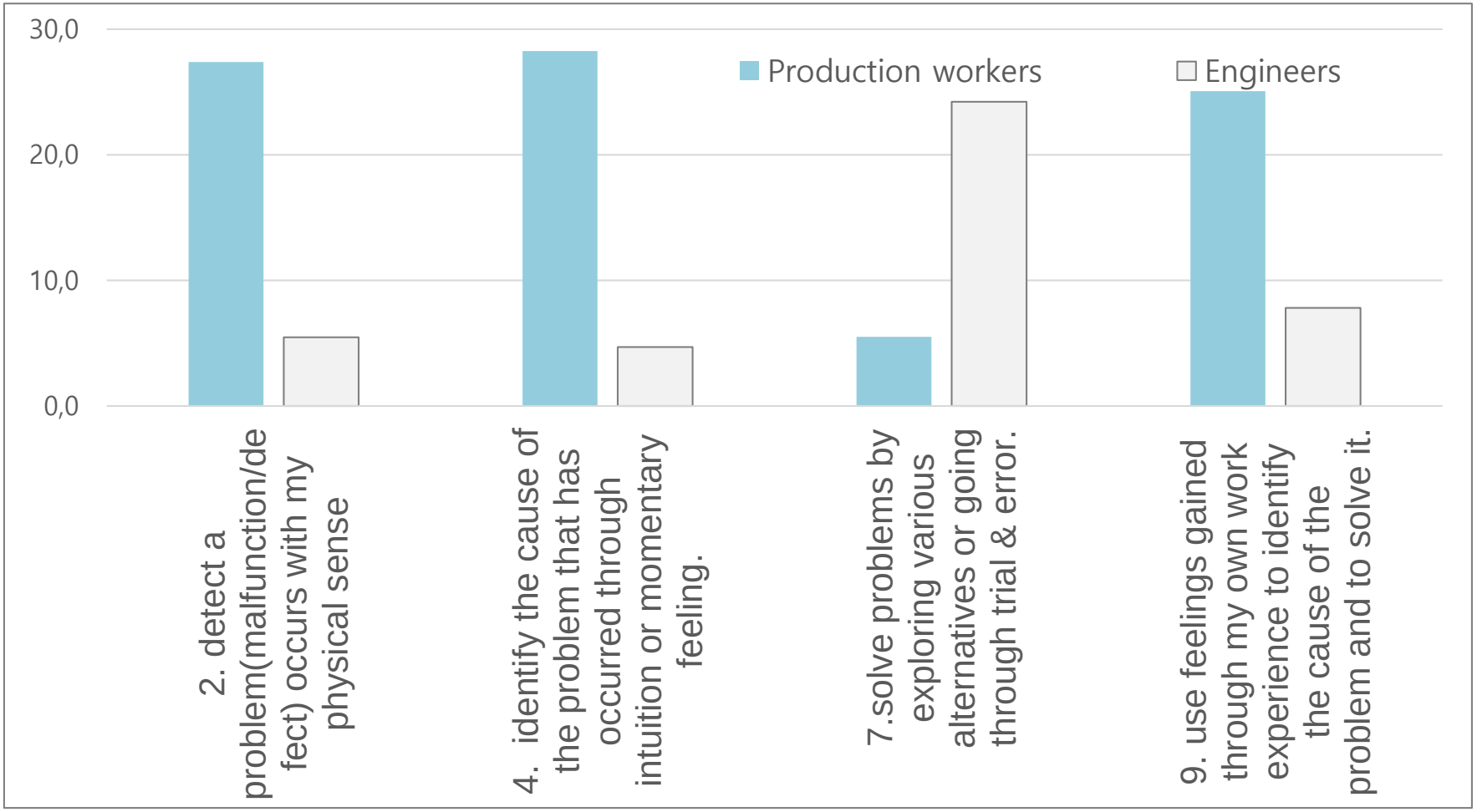
* Edited with reference to Pfeiffer (2016)

Objectifying work action



- Y axis: ‘percentage of ‘③often’
- Objectifying action of Engineers (30%+) is higher than that of production workers(10%)

Subjectifiying work action



- Production workers' subjectifying action (25%) is higher than that of Engineers (5%)
- "7. by exploring…" is high in Engineers (25%) than in production workers (5%)

Tab. 2. Facing the complex problems

(%)

How often do 'the complex problems' occur in your job?	Engineers	Machinery mechanics and fitters, repairers	Operators, process controllers, assemblers
Rarely occurs or Occurs less than once a month	56.3	64.8	76
Occurs more than once a month	21.9	30	19.2
Occurs more than once a week or occurs everyday	21.9	5.1	4.8
No. of respondents	128	253	437

- Engineers (21.9%) face complex problems more often than production workers(5.1%)

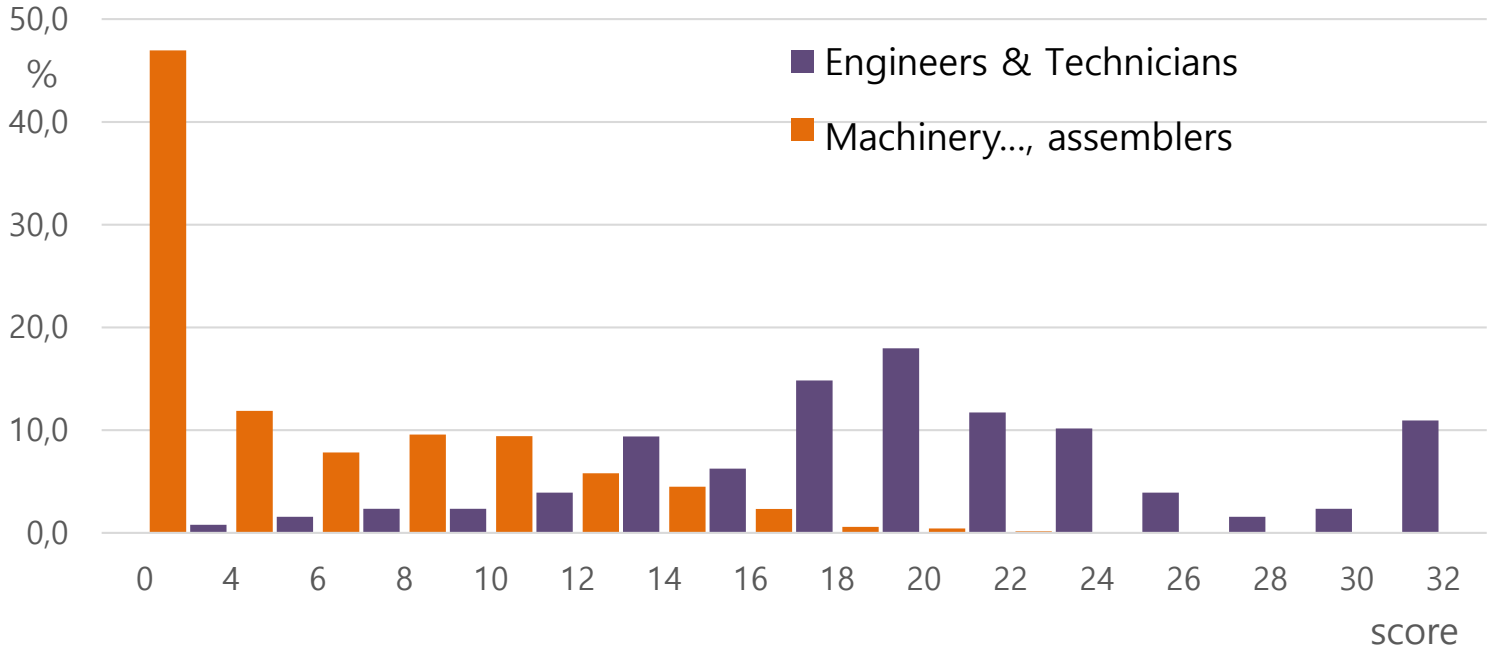
Tab. 3. Scope of problem solving

(%)

To what extent do you solve the problems in your job?	23. Engineers	7. Machinery mechanics & fitters, repairers	8. Operators, Process controllers, assemblers
① Does not solve any problems	4.7	9.5	22.2
② Solves only simple problems	33.6	40.3	49.9
③ Solve some complex problems	40.6	27.3	17.9
④ Solve mostly complex problems	21.1	22.9	10.1
Total	100	100	100

- Engineers & technicians are more inclined to deal with complex problems, while production workers more tend to deal with simple things.

Fig. 4. Score of computer use *



- Production workers' score are distributed lower than Engineers' one

* The score is the sum of the use of the following computer tech.** and the tasks performed (operation, maintenance, repair, tool replacement, troubleshooting, setting/programming) :
** Engineers: 1. Macros or equations in spreadsheets such as Excel, 2. Editing or improving the program, 3. Database, 4. Database queries such as SQL (structured query language), 5. CAD, 6. Scientific/engineering professional programming, 7. Programming, 8. Special purpose software.
** Production workers:1. to read instructions, etc., 2. to enter numbers or letters, 3. to analyze data with Excel, etc., 4. to design products with CAD, etc., 5. to edit or improve programs, 6. to program

Tab. 5 Use of automation machines by occupation

	NC/CNC, Machining center	Robots	Other automated or semi-automated machines	Hand-operated large mechanical equipment	PLC *	CPC*	n
23. Engineers & Technicians	6.3	4.7	13.3	7.0	14.8	8.6	128
7. Macinery mechanics …	6.7	0.8	29.2	17.8	8.3	2.0	253
8. Operators, …	10.8	10.8	71.2	30.2	9.2	2.1	437

7. Machinery mechanics and fitters, repairers, 8. Operators, process controllers, assemblers
* PLC: Programmable Logic Controller, CPC: Computer Process Controller

- The response rate of ‘use of automation machines’ was as low as 10%

Tab. 6 Status of Smart Factory in SMEs: 2014-2019, Korea

	Level	Standard	SMEs [1)]	Conditions(Level of construction) [2)]	Main tools
Advanced	5	Autonomous operation		Autonomous progress from monitoring to control and optimization	AR/VR, CPS
Medium 2	4	Optimization	1.50%	Possible to respond in advance through process operation simulation	Sensor controller optimization tool
Medium 1	3	Control	20.60%	Control by analyzing collected information	Sensor+analytical tool
Basic	2	Monitoring	77.90%	Monitoring of production information is possible in real time	Sensor
	1	Check		Partial standardization and data management	Barcode RFID

1) 12,660 companies that received government support for related during 2014-2019

2) Five Requirements for Smart Factory: Digitization of 4M+1E, Integration, Connection with Smart System, Intelligence, Creation of Engineering knowledge.

- Source: Ministry of SMEs and Startups(2022), www.smart-factory.kr/eng/

➢ The introduction of “Smart factory” is at an early stage in Korea.

Tab. 7 Estimation results: Ordered Logit

Dependent var.: Subjectifying work action		Engineers & Technicians	Production workers
male		-0.554	1.005***
school dummy 1)	gen-high(9yr)		-0.043
	voc_high(9yr)		-0.466
	college(11yr)		-0.437
	univ(14yr)	0.405	-0.803*
	post-2nd(16yr+)	0.731	
Tenure in current job		0.048	0.050***
Skill-level dummy 1)	skilled worker		1.127***
	foreman/group leader		1.119***
	master craftsman		1.073***
Number of tasks in charge		0.139	0.472***
Non-repeatability of tasks in charge		-0.1	0.119
Degree of Multi-tasking in the job		0.949***	0.287***
Degree of group activities to solve problems		0.366***	-0.247***
Frequency of facing complex problems		0.191	0.322***
Objectifying score		0.371***	0.105**
Scope of problem solving		0.207	-0.301**
Level of computer tech. use		0.044#	0.063***
Level of automated machines using	NC/CNC, MCT		0.009
	Robot		-0.081
	PLC(programmable logic controller)		-0.163***
	CPC(computer process control)		0.209*
N		128	690
Log-Likelihood		-204.8	-1164.5

1) Base is below 9 years, ‘unskilled worker‘ and controlled the occupation(2 digit level). VIF of OLS=1.7, 1.9
2) * p<.1; ** p<.05; *** p<.01 ; # p<.101

Implication-1

1. As a result of estimating subjectifying action as a dependent variable, the coefficient of objectifying action was positive (+).

- Subjectifying work action is complementary to the objectifying action. This result is also in line with the 'subjectifying workarounds of workers that go beyond standards', as Pfeiffer (2016) argued.
- For engineers(0.371***), when faced with complex problems, they make ‘work manual’ a high priority that reflects ‘professional expertise’
- For production workers(0.105**), this complementarity would be less than that of engineers.

Implication-2

2. Production workers' subjectifying action was influenced by work experience variables such as job tenure, experience in facing complex problems, and handling multiple tasks.

- This means that production workers' subjectifying actions are significantly affected by institutional conditions such as long-term employment, career development systems. Also they were less active in exploring various alternatives or going though trial & error when solving a problem in Korea.

- As the solving complex problems is expected to become more important, it is necessary to redefine the skills of production workers and to seek vocational training policy directions.

Implications-3

3. The higher the score of computer use, the more active the subjectifying work action. But, for the level of automated machine use, the sign was insignificant.
   - Only PLC & robot were significantly negative(-)

1) Subjectifying action is likely to be influenced more significantly by the level of systematization of automation in the workplace than by one's use of a unit of machine.

- Computer tech. is already embedded in most production systems.
- Digitalization is at an early stage in Korean SMEs (Tab. 6).

2) When the level of automation increases, it suggests that work manuals and skills must be well developed and work organization must be coordinated for subjectifying work action to be activated..

- The Korean government is supporting 'Smart Factory promotion'. Research on changes in skill requirements needs to be done.

Conclusion

- Pfeiffer (2016) saw that subjectifying action is quite required and plays a certain role in case of assembly workers.
- I thought that a subjectifying action would be operating in Germany's highly structured workplace system, such as the 'highly networked automated machines, integrated production system, and corporatism tradition'.

- In Korean SMEs, subjectifying action was significantly affected by workers' experience, but no consistent relationship was confirmed with the use of automation technology except for computers.
- Digitalization is at an early stage in SMEs' manufacturing
- Complex problem solving is left to engineers, while production workers tend to handle simple problems. It partly relates to the fact that setting tasks* is often not entrusted to production workers.

*CNC setting, robot program setting/teaching, monitoring/supervision of normal operation. (Y. Nho et al.)

References

- Sabine Pfeiffer(2016), Robots, Industry 4.0 and Humans, or Why Assembly work is More than Routine Work. Societies, 6, 16.

- Yongjin Nho and Me-Rhan Kim(2022), What Affects Job Contents and Skills Requirement of Automation Operators? : The Case of Robots, Korean J. Labor Studies, 28:1:169-200. in Korean.

Thank you for your attention!

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Appendix

Descriptive statistics on subjectifying work action

		Engineers				Production workers			
		Mean	s.d.	Min	Max	Mean	s.d.	Min	Max
	Objectifying action	9.16	2.07	4	12	6.17	1.96	4	12
	Sbjectifying action	6.48	1.76	4	11	7.35	2.17	4	11
O	Q15_1	2.04	0.76	1	3	1.79	0.69	1	3
O	Q15_3	2.30	0.69	1	3	1.40	0.60	1	3
O	Q15_5	2.39	0.64	1	3	1.55	0.66	1	3
O	Q15_8	2.43	0.57	1	3	1.42	0.58	1	3
S	Q15_2	1.33	0.58	1	3	1.92	0.79	1	3
S	Q15_4	1.49	0.59	1	3	1.95	0.78	1	3
S	Q15_7	1.95	0.74	1	3	1.50	0.60	1	3
S	Q15_9	1.71	0.60	1	3	1.98	0.72	1	3
	n=128					n=690			

Data from ‘Survey on Skill Requirements(SSR)’ by KRIVET