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Empirical Analysis: Technological character, type of function, and longevity of standardized knowledge

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Abstract

This study determines the validity of the current de jure standards management system. The de jure standard is an important tool for innovation policy, and also forms part of the social infrastructure. However, its management system, following standards formation, has not been well investigated. Its review interval has been fixed in the management system and maintained without empirical examinations. The validity of a fixed review interval is examined in this study. For this purpose, the factors that could potentially influence the longevity of standards are examined, and ways to improve the management system of de jure standards are discussed. The de jure standard is used in both developing and developed countries; hence, the policy implications are applicable across the world. This study finds through the empirical analysis that the type (or function) of de jure standards (e.g., design and mark standards) influences longevity. The influence of designs on innovation is an emerging research area that is currently studied through the analysis of design patent data. However, the design and mark standards have not been well studied from an economic perspective. In sum, this study has the following contributions: 1) Technological categories have significantly different effects on longevity, and the longevity of some technological sectors is longer than others, which indicates a need for a more flexible interval system, 2) The results indicate that the longevity of the design and mark standard is longer than that of other types of standards, and 3) Longevity is not significant in the information technology category. This result could support the argument that information technology becomes a General Purpose Technology (GPT).

Keywords: De jure standards, Technological category, Design and mark, General Purpose Technology.
JEL: O30, O31, O34, L15.

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1. INTRODUCTION

This study determines the validity of the current de jure standards management system; the outcome thereof has policy implications. The central concern is whether the current fixed review interval system across technological categories is valid. The de jure standard is an important tool for innovation policy. However, its review interval has been fixed in the management system and maintained without empirical examination. For the purpose of this study, the factors that could potentially influence the longevity of standards are examined, and ways to improve the management system of de jure standards are discussed. The introduction and maintenance of standards has a financial as well as a labor cost. Hence, the review interval could be extended and the costs could be reduced if the marginal effect of a factor on the longevity of standards is sufficient. Alternatively, the review interval could be reduced.

This study used "e-JISC," which is maintained and provided by the Japanese Industrial Standards Committee (JISC). The e-JISC system reports on past as well as current Japanese Industrial Standards (JIS) data, and records the beginning and the end of each standard (as well as related information) definitively. Standards are reviewed every five years for termination, amendment, or retention. This process has remained the same for several decades. It is common to base review systems on fixed terms, regardless of technological categories. It is the same even in the International Organization for Standardization (ISO). However, from an economic perspective, standards developing organizations (SDOs) do not discuss the optimal review interval empirically, even in the 21st century.

This study finds through the empirical analysis that design and mark standards influence longevity. The influence of designs on innovation is an emerging research area that is currently studied through the analysis of design patent data. In sum, this study has major contributions:

1) Technological categories have significantly different effects on longevity. The longevity of some technological sectors is longer while that of others is shorter, which indicates a need for a more flexible interval system.

2) The longevity of the design and mark standard is longer.

3) Longevity is not significant in the technological category of information processing. This result could support the argument that information technology becomes a General Purpose Technology (GPT).

4) The longevity of production standards in de jure standards is longer than that of measurement standards. This seems different from the tendency of de facto standards. It implies that the production standard is developed for raw materials rather than commercial goods and is not influenced by market changes.

2. LITERATURE REVIEW

2.1 Effective Terms of Standards

Since empirical research on the effective terms of a standard is an emerging field, the topic is not yet well studied. Much research has focused on the effective terms of de facto standards, while few studies have focused on de jure standards. Two main factors influence a standard, namely 1) technological category and 2) type (or function) of standard. David (1985) investigated the longevity of the de facto standard of the QWERTY typewriter, and showed that it has been effective without amendment approximately for a century in spite of changes in the technological and economic environment. David (1985)'s research discusses the persistence of standards due to the lock-in effect that arises from human learning. However, it neglects all factors related to technological characteristics and market dynamics. Yamada and Kurokawa (2005) focus on technological differences and present a case study on the longevity of de facto standards in commercial audiovisual and information technology products. However, the research does not provide sufficient statistical results, even though it shows that the market share of a product relates to the formation of the de facto standard. The EU de jure standards of telecommunication and information technology are surveyed through a survival analysis that is informed by data from the PERINORM database. It is reported that some factors (such as amendment) have a significant effect on the hazard ratio (Blind, 2007). The amendment of a standard has a significant influence on the longevity thereof. However, the EU research focuses on the bibliographic perspective, and does not consider the economic environment.

2.2 Type of Standard

Blind and Gauch (2009) emphasize the importance of the basic function of de jure standards, such as the definition of terminology and safety criteria in emerging R&D fronts such as nanotechnology. However, in the EU's survival analysis research of the de jure standards, the influence of the type of standards is not fully considered (Blind, 2007).

2.3 Related Literature

2.3.1 International standardizations. The role of international standards in trade facilitation was recognized more widely since the ratification of the Technical Barriers to Trade (TBT) agreement of the World Trade Organization (WTO). The positive effect of international standards on trade is shown (Blind and Jungmittag, 2005). In addition, in the EU de jure standards, international references tend to have a significant positive influence on the hazard ratio of the longevity of telecommunication standards (which means that the longevity of such standards tends to be shorter). They tend to have a significant negative effect on the hazard ratio of the longevity of information technology standards (which means that the longevity of such standards tends to be longer) (Blind, 2007).

2.3.2 Legislative usage. De jure standards often have legislative use in safety and quality regulation. Quality standards aim to improve the product's quality in a market (Maxwell, 1998). Hence, this role requires stability; it ultimately affects the longevity of the JIS, which have been quoted about 6,500 times in different Japanese laws (e.g., the Pharmaceutical Affairs Act) (Japanese Industrial Standards Committee, 2013).

2.3.3 Economic environment. The longevity of the standard can be influenced by the economic environment, where standards terminate. The survival analysis of EU standards does not control for this factor (Blind, 2007). Hence, this study controls for the effect of the economic environment, where standards become ineffective.

3. HYPOTHESES

Based on knowledge from empirical results and literatures, the following hypotheses are formulated for the empirical analysis:

Hypothesis 1: Standards in different technological categories have significantly longer or shorter longevity.

Hypothesis 2: The type of standards has a significant influence on longevity.

4. MODEL AND METHOD

This study assumes a functional relationship between the dependent variable and variables of interest. To estimate the functional relationship, a linear combination of variables is assumed and parameters are estimated.

4.1 Variables

This study introduces longevity as a dependent variable and 1) technological category, 2) amendment, 3) type of standard, 4) international standardization, 5) legislative usage, and 6) end year as independent variables. A detailed description of each variable is provided in Table 1.

[Insert Table 1]

4.1.1 Technological category. Some technological categories tend to have longer and others shorter longevity. This study used the JIS technological categorization (Japanese Industrial Standards Committee, 2013) to observe the sectorial tendency and analyze the differences.

4.1.2 Type of standard. The type (or function) of standards is assumed to be associated with longevity. However, previous studies paid attention to differences in terms of the effect of standards (such as compatibility and variety reduction) rather than the type of standards (such as design and mark) (Blind, 2004). In this study, the effect of design and mark standards is surveyed. In general, the longevity of production-related standards is believed to be shorter than that of design and mark standards and, measurement standards, since product lifetime could be diminished due to technological obsolescence.

4.1.3 Amendment. The eventual progress of the related technology is incorporated when standards are amended. Amendment is likely to extend the longevity of the standards. To control for this effect, the amendment is included in the estimation factors. In the research of the EU de jure standard, the hazard ratios tended to give mixed results (that is, larger or smaller) in the Cox survival analysis, in the case of the amendment (Blind, 2007).

4.2 Model

Since the theoretical structure of standards' longevity is not often discussed, the following model was prepared mainly according to the result of previous research (Blind, 2007). The following functional relationship between factors is assumed:

$$LONG=f\,(TEC,\ TYPE,\ AMEND,\ INTER,\ LEG,\ and\ ENDY),\quad f(\cdot)'>0. \qquad (1)$$

I developed Equation (2) as the summation of variables for the purpose of parametric estimations.

Model 1: $long = \boldsymbol{X\beta} + u,$ (2)

where $\boldsymbol{X}$ is a vector matrix of variables, the constant $\boldsymbol{\beta}$ is the vector matrix of coefficients, and u is an error term. $\boldsymbol{X}$ includes the policy variables(i.e., TEC, TYPE, and AMEND), and the control variables (i.e., INTER, LEG, and ENDY). The latter variable "ENDY" represents the termination of the 10-year period, when standards expire. The generation effect of the initiation of standards is not included, since the factor shows multicollinearity.

To check the robustness of Model 1, I introduce Model 2, in which dummy variables to explore the functional effect of the type of standards is included as an additional policy variable (i.e., i) production, ii) measurement, and iii) design and mark).

All other variables are the same as in Model 1. For both models, "Civil engineering and architecture" (tc1) (*Technological category*), year10e1 (*End year*), and type_p (*Type of standard*) are used as baselines. Owing to its large number of observations, I use "Civil engineering and architecture" as the baseline category.

4.3 Method

For the parametric estimation (***β***), the robust ordinary least square estimation was used, which uses White-Huber standard errors, rather than OLS to improve the robustness to the heteroskedasticity of the error term. The mean VIF (Variance Inflation Factor) of each model was used to assess multicollinearity, and the F-value was used to determine if all coefficients were simultaneously zero. STATA was used for the parametric estimation and the preparation of graphs.

5. DATA SET

For the parametric estimation of the coefficients vector ***β***, data on JIS were acquired from the e-JISC database. As of 2012, about 12,000 JIS de jure standards are effective (Japanese Industrial Standards Committee, 2013). In the past, approximately 7,600 JIS have been terminated. Of these past JIS, 4,483 with complete data as of 2014 were used for the parametric estimation. Some categories show a Gaussian distribution. Skewness and kurtosis tests for normality (Kolmogorov-Smirnov test) were done. The categories (i.e., D: Automotive engineering, H: Non-ferrous materials and metallurgy, M: Mining, and Q: Management system) show significant fit to the Gaussian distribution. The standards are categorized into three types, namely i) production standard, ii) measurement standard, and iii) design and mark standard. The dependent variable, *longevity of standards*, is measured in years. The list of design and mark standards is shown (Appendix A). The yearly distribution of standard types (i.e., i) production, ii) measurement, and iii) design and mark) represents the yearly distribution of longevity for each technological category along with descriptive statistics (Appendix B)[1].

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[1] As a result, the longevity of the standards shows a continuous distribution. One of the main reasons is that the review process takes more (or less) time than originally anticipated due to administrative reasons although it is typically scheduled as a five-year process.

6. RESULTS AND DISCUSSION

Table 2 presents the results of the parametric estimation for vector $\boldsymbol{\beta}$.

[Insert Table 2]

As for the robustness of the estimation, the R^2 value increases from Model 1 to Model 2 (ΔR^2 is 0.005). The F test for all coefficients being zero at the same time is rejected in Model 1 and Model 2. The mean VIF of all variables is 2.00 in both models, and multicollinearity does not occur in either model. The heteroskedasticity test (Breusch-Pagan test) indicated the presence of heteroskedasticity, and the robust OLS estimation was therefore used.

6.1 Technological Category

Hypothesis 1 cannot be rejected. From the data obtained, two categories can be identified for the influence of technological categories on longevity: 1) coefficients are larger than five years or 2) coefficients are smaller than five years (including negative values). From the $\boldsymbol{\beta}$ of model 2, in the technology of the category Ⅰ (e.g., P: Pulp and paper, and G: Ferrous materials and metallurgy), the review period can extend longer than the current five years, and the administrative cost of de jure standard management can be reduced. From the same model, in the technology of the category Ⅱ (e.g., C: Electronic and electrical engineering, and Q: Management system), the review interval can be reduced to less than five years and the contents of the standard can be updated so as to adjust to technological development and reach markets promptly. Results indicate the possible alternative hypothesis that some technological categories are neutral on longevity, since some categories (e.g., X: Information processing, and W: Aircraft and aviation) do not show significant influences on their longevity. This result also supports the argument that information technology is one of the General Purpose Technologies (GPT) (Lipsey, Carlaw, and Bekar, 2005). Since information technology becomes the universal technology, longevity is not significant in the technological category. Empirical results from this study provide this evidence.

6.2 Type of Standard

Hypothesis 2 cannot be rejected. The type of standard has a significant effect on longevity. The design and mark standard has a longer influence than the production or measurement standards. This result is in line with general scholars' views, since the design and mark is a basic element of technology and has longer longevity. To our knowledge, this is the first empirical evidence for this result. On the other hand, the measurement standard shows a shorter longevity influence on standards. This is not in line with scholars' general understanding, since the measurement is difficult to change once standards are set. One of the reasons for this result seems to be the contents of production standards. In the case of JIS (i.e., de jure standards), the production standard contains standards of production goods such as Benzoic acid (K4127). These basic raw materials are used for production of other products. Hence, such standards of production goods do not seem influenced by the consumer market directly and the technical obsolescence is not as fast as that of the consumer goods market. This can lead to longer longevity. This is different from de facto standards, which mainly include consumer goods in consumer markets. This argument and the obtained result lead to the novel proposition that de jure production standards can have longer longevity than de facto production standards. The other reason for this result seems to be the contents of production standards. In this study, I classified all JIS standards that do not fit with the design and mark standard or the measurement standard, as production standards. Hence, the heterogeneity of the classified production standard might be high, which could cause this result.

6.3 Amendment

The amendment experience of standards has a significant influence on longevity, with the largest coefficient value of 17. This means that through amendment, a standard can be updated technologically and its longevity increased. This result is partially in line with the Cox survival analysis result of the EU de jure standards (Blind, 2007).

6.4 Advantage and Disadvantage of the Analysis

The advantage of this proposed algorithm is that the longevity of each standard is directly estimated, and the marginal effect is clearly estimated. In the case of the semi-parametric Cox survival analysis of previous research (Blind, 2007), the result is a relative figure; it is difficult to compare the absolute value of five years with a coefficient. On the other hand, a disadvantage of this study is that this estimation analysis uses mainly dummy variables. In such a case, multicollinearity tends to occur and the result tends to be unstable. However, in the current set of variables, the mean VIF value remains sufficiently low (i.e., approximately 2.00).

Further, the interaction term between the technological category and the type of technology is not included in the estimation models of this study, because the data regarding the type of technology are sparser than those of the technological category. The accumulation of further data will resolve this issue.

7. CONCLUSION

The longevity of de jure standards is explored in this study. In the process, I find that the type of standard significantly influences the longevity. Specifically, design and mark standards show a significant positive impact on the longevity. Previously, the type of standard was mainly discussed from a process or production perspective; hence, herein is the novelty of this study. In addition, the importance of designs for innovation is widely recognized. This result will therefore provide a baseline for researchers who are interested in the effect of designs on innovation and intellectual property rights.

The results show a significant correlation between the technological category and the longevity of standards. The heterogeneity of JIS technological categories shows a significant effect on the de jure standards’ longevity. This study focused on the norm of standards management that the review interval is fixed regardless of technological categories. This dogma has not been questioned for almost a century. The results show that the optimum review period is different in each technological category. These results for de jure standard dynamics can be beneficial to public agencies in Japan, and for international de jure standard SDOs (e.g., ISO and the International Electrotechnical Commission

(IEC)).

Regarding policy implications, the current standard management system has not been well studied empirically to determine whether aspects such as the review interval, are appropriate. This is very different from the case of the patent system, for which the maintenance system is studied academically to improve the policy regime. This study finds that some technological categories should preferably have a longer and others a shorter review period. The implication will be more effective management of standards, leading to rapid market access.

Limitations of this study include the assumption that the structure of R&D policy—including the intellectual property policy—is stable and remains the same for the consideration of policy implications for SDOs. However, the longevity of the de jure standard is sometimes as long as several decades. Hence, the past identification of the influence of technological categories may not be appropriate for future policy planning, as critiqued by Lucas (1976). This study's result bases on the evidence from past standards, but I believe the result has meaning for future policy planning.

This study categorized all unclearly categorized standards into production standards. Such treatment could cause heterogeneity in production standards and result in measurement standards tending to have shorter longevity than production standards, which may differ from the general perception about measurement standards. Hence, as a subject for further research, it may be necessary to refine this point to exclude the unmatched standards from the production standard category and propose a new category. For this purpose, the contents of each standard needs to be reviewed. However, for the purpose of understanding the influence of design and mark standards, this study presents a significant result.

Appendices:

Appendix A. JIS code of design and mark standards

[Insert Appendix A here]

Appendix B. Distributions of longevity

[Insert Appendix B here]

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Tables:

Table 1. Variables

Variable type	**Variable**	**Symbol in analytical results**	**Definition**	**Notes**
Dependent variable	LONG	long	*Longevity of standard:* number of years for which the standard has been effective.	
Independent variable	TEC	tc1, tc2, …,tc12	*Technological category:* dummy variable for presenting the category of technology. If the value is 1, the standard belongs to the technological category. The tc1 is the baseline.	
	TYPE	type_p type_m type_d	*Type of standard:* dummy variables for presenting the effect of standard: i) "type_p" denotes a production standard, ii) "type_m" denotes a measurement standard, and iii) "type_d" denotes a design and mark standard. If the value is 1, the standard is of the specific type. The type_p is the baseline.	
	AMEND	amend	*Amendment*: dummy variable for presenting whether a standard has been amended or not. If the value is 1, the standard has been amended.	
	INTER	iso_iec	*International standardization:* dummy variable for presenting international standardization. If the value is 1, the standard has the same content as the corresponding international standard.	Control variable
	LEG	legislation	*Legislative usage:* dummy variable for presenting legislative usages. If the value is 1, the standard is used for legislative purposes.	Control variable
	ENDY	year10e1 year10e2 year10e3 year10e4	*End year*: year in which a standard is terminated (ten-year categorization basis). If the value is 1, the standard is terminated within the ten-year interval. The year10e1 is the baseline.	Control variable

Table 2. Result of estimation

Dependent variable: long														
Independent variable	Model 1						Model 2						note (Japanese Industrial Standards Committee, 2013)	
1. Variable of interest	Coefficient	Standardized Coefficient	Robust standard error	t-value	Coefficient larger than five (Category	Coefficient smaller than five (Category	Coefficient	Standardized Coefficient	Robust standard error	t-value	Coefficient larger than five (Category	Coefficient smaller than five (Category Ⅱ)	JIS technological code	Technological category name
tc1	(Baseline)						(Baseline)						A	Civil engineering and architecture
tc2	6.396	0.155	0.764	8.37***	✓		6.008	0.146	0.765	7.85***	✓		B	Mechanical engineering
tc3	4.401	0.105	0.792	5.55***		✓	3.999	0.096	0.788	5.07***		✓	C	Electronic and electrical engineering
tc4	5.958	0.066	1.023	5.82***	✓		6.071	0.067	1.007	6.03***	✓		D	Automotive engineering
tc5	4.756	0.058	0.927	5.13***		✓	4.403	0.054	0.933	4.72***		✓	E	Railway engineering
tc6	8.663	0.156	0.873	9.92***	✓		8.081	0.146	0 .878	9.20***	✓		F	Shipbuilding
tc7	9.023	0.089	1.351	6.67***	✓		8.824	0.087	1.396	6.32***	✓		G	Ferrous materials and metallurgy
tc8	4.858	0.061	1.092	4.45***		✓	5.372	0.067	1.089	4.93***	✓		H	Non ferrous materials and metallurgy
tc9	8.223	0.244	0.732	11.23***	✓		8.045	0.239	0.728	11.05***	✓		K	Chemical engineering
tc10	8.211	0.108	0.998	8.22***	✓		8.099	0.107	0.992	8.16***	✓		L	Textile engineering
tc11	8.257	0.086	1.140	7.24***	✓		8.045	0.083	1.163	6.91***	✓		M	Mining
tc12	10.209	0.086	0.958	10.65***	✓		10.941	0.092	0.985	11.10***	✓		P	Pulp and paper
tc13	-1.766	-0.007	1.269	-1.39	−	−	-2.732	-0.011	1.301	-2.10**		✓	Q	Management system
tc14	8.580	0.087	1.218	7.04***	✓		8.767	0.089	1.234	7.10***	✓		R	Ceramics
tc15	-0.636	-0.008	1.006	-0.63	−	−	-1.126	-0.015	1.000	-1.13	−	−	S	Domestic wares
tc16	8.747	0.115	1.011	8.65***	✓		8.113	0.106	1.016	7.98***	✓		T	Medical equipment and safety appliances
tc17	0.877	0.007	1.232	0.71	−	−	0.693	0.057	1.230	0.56	−	−	W	Aircraft and aviation
tc18	0.426	0.006	0.919	0.46	−	−	-0.661	-0.010	0.931	-0.71	−	−	X	Information processing
tc19	6.679	0.123	0.878	7.60	✓		6.586	0.121	0.880	7.48***	✓		Z	Miscellaneous
type_p							(Baseline)							
type_m							-2..419	-0.068	0.411	-5.88***				
type_d							3.489	0.032	1.195	2.92***				
amend							17.409	0.573	0.384	45.32***				
constant	5.368	0	0.947	5.66***			5.935	0	0.946	6.27**				
2. Control variable														
iso_iec	yes						yes							
legislation	yes						yes							
year10e1 *year10e2* *year10e3* *year10e4*	yes						yes							
R-squared	0.498						0.503							
ΔR-squared between model1 and model2	-						0.005							
Test for all variables: All variables = 0 ? *F value/ Prob>F*	267.4/ 0.000						251.0/ 0.000							
Number of subjects	4483						4483							
Mean VIF for all variables	2.06						2.00							

NOTE: t-value, * **p < 0.01, ** p < 0.05, * p < 0.1.
Control variables: international standardization (*iso_iec*), legal status (*legislation*), and end year (*en_year*) are included in both models.

Appendices:

Appendix A. JIS code of design and mark standards

TABLE A1. JIS code of design and mark standards in technological categories

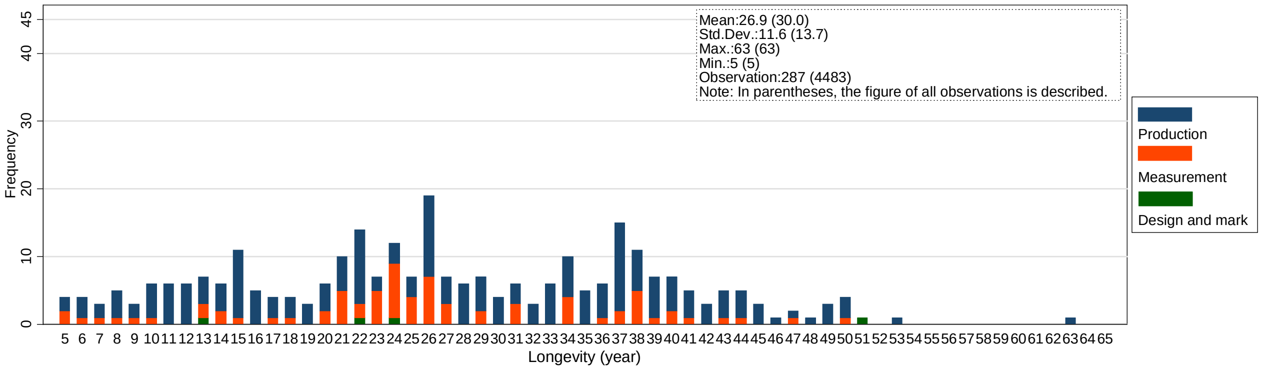
	A:Civil engineering and architecture	**B:Mechanical engineering**	**C:Electronic and electrical engineering**	**D:Automotive engineering**	**E:Railway engineering**	**F:Shipbuilding**	**K:Chemical engineering**	**L:Textile engineering**	**M:Mining**	**R:Ceramics**	**S:Domestic wares**	**T:Medical equipment and safety appliances**	**X:Information processing**	**Z:Miscellaneous**
JIS CODE	A0151 A8310 A8904 A9514	B0002 B0125 B0218 B1536 B1701 B1722 B2210 B2406 B5002 B6012 B6109 B7170 B7176 B8032 B8366 B8434 B9070 B9126 B9516 B9614	C0301 C0802 C0901 C0903 C2513 C2515 C2517 C2518 C5143 C6010 C6104 C7009 C7103 C7104 C9309	D3603 D4201 D5206 D6103 D6107	E7202	F0411 F8011 F8012 F8601	K6811 K7537 K7556 K7651	L0203 L5121	M2006 M3902 M3907 M3914 M3915	R2102 R2103 R6211	S1071 S7101	T1006	X0122 X0207 X0801 X0802 X6001	Z2343 Z3031 Z4911 Z8202 Z8250 Z9201

Note1: N=77 (as of 2014)

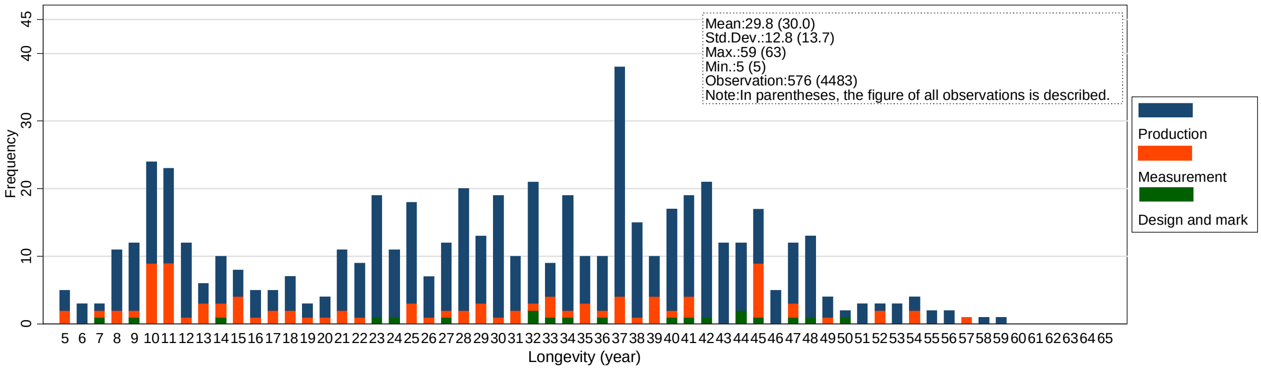
Note2: G:Ferrous materials and metallurgy , H:Non ferrous materials and metallurgy, P:Pulp and paper, Q:Management system, and W:Aircraft and aviation do not have design and mark standards.

Appendix B. Distributions of longevity

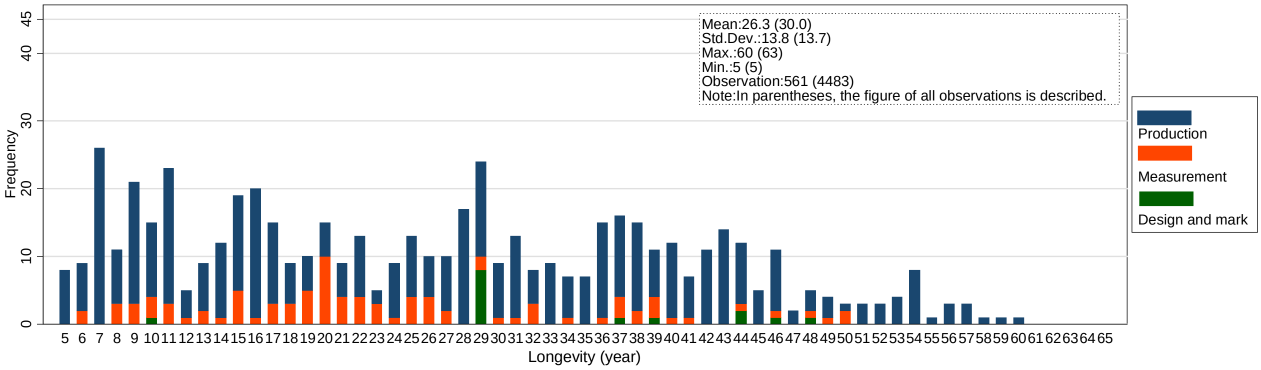
Appendix B1. Distribution of longevity (A: Civil engineering and architecture)



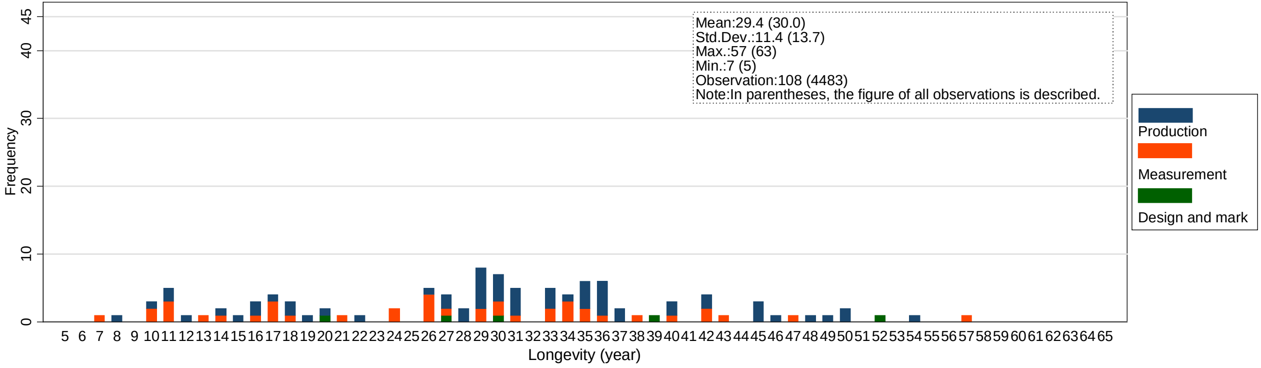
Appendix B2. Distribution of longevity(B: Mechanical engineering)



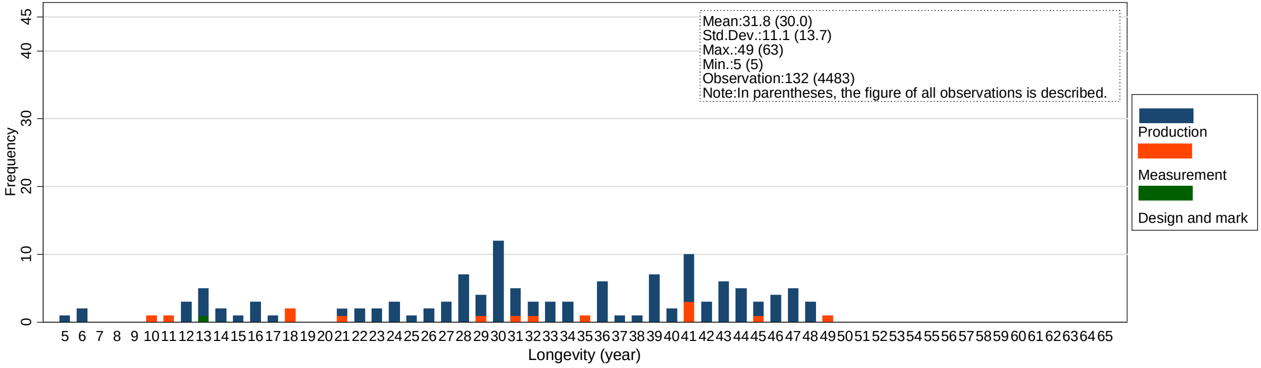
Appendix B3. Distribution of longevity(C: Electronic and electrical engineering)



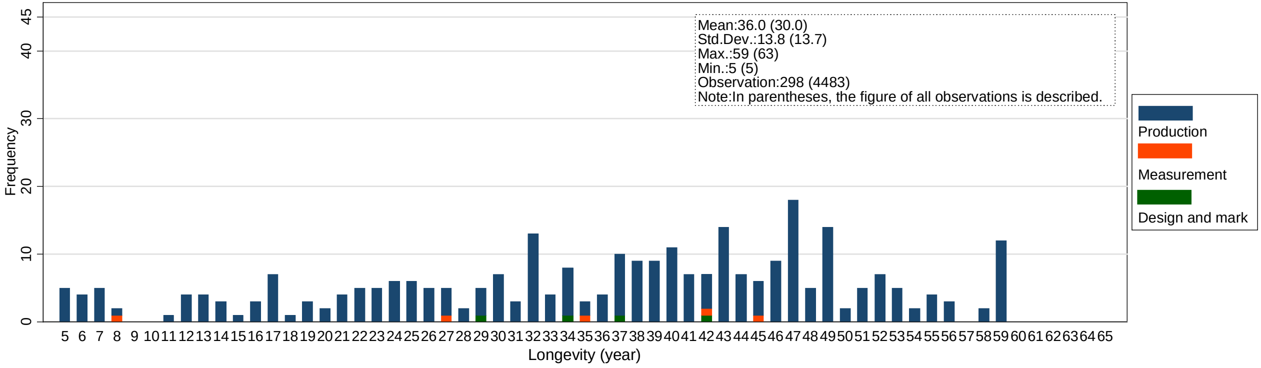
Appendix B4. Distribution of longevity (D: Automotive engineering)



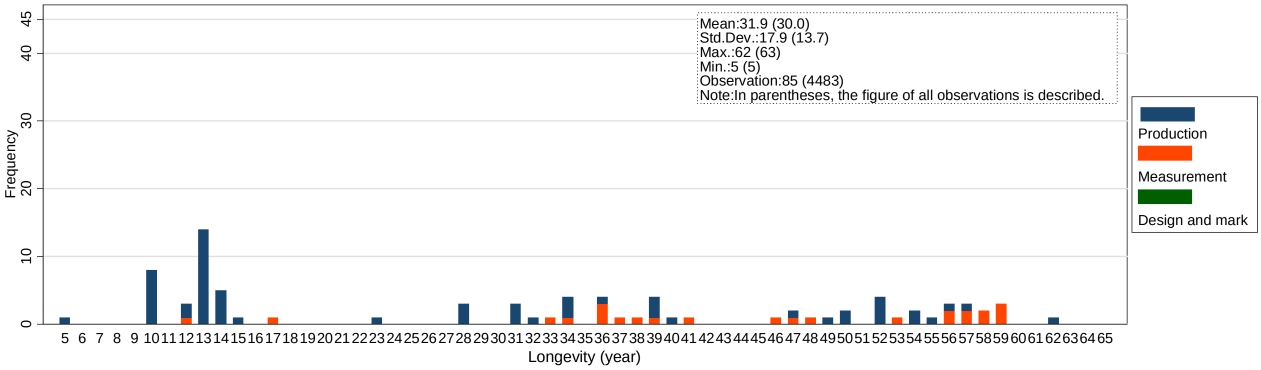
Appendix B5. Distribution of longevity (E: Railway engineering)



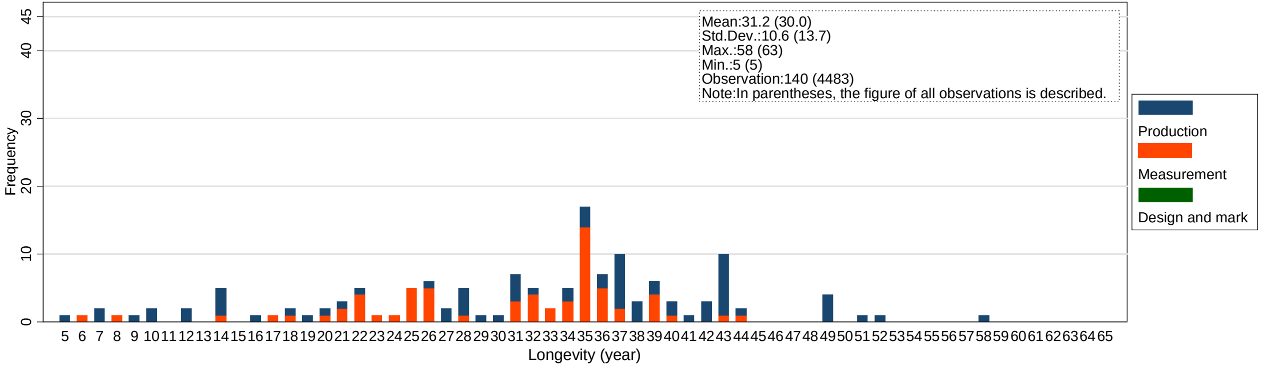
Appendix B6. Distribution of longevity (F: Shipbuilding)



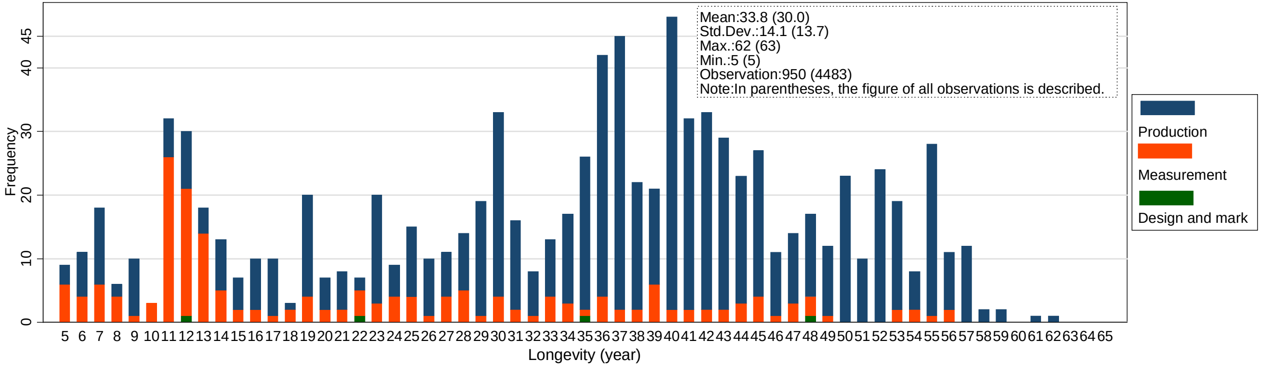
Appendix B7. Distribution of longevity (G: Ferrous materials and metallurgy)



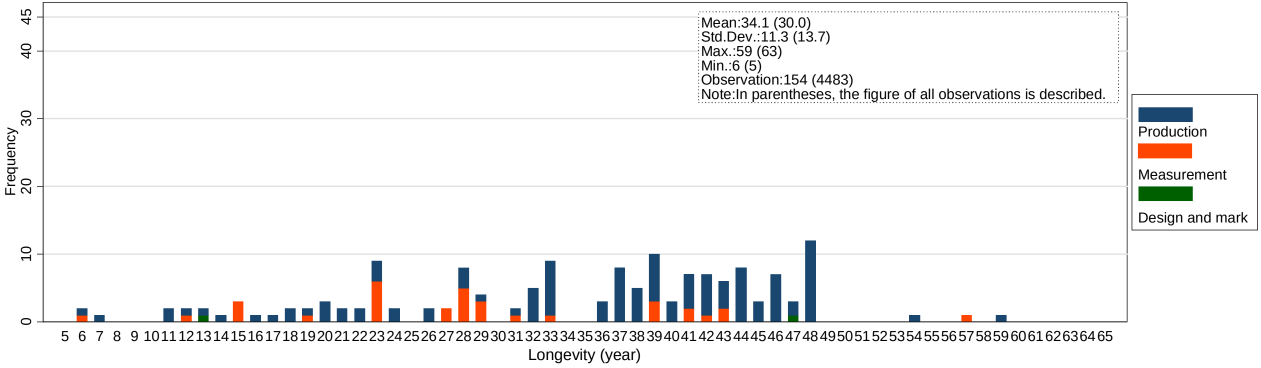
Appendix B8. Distribution of longevity (H: Non ferrous materials and metallurgy)



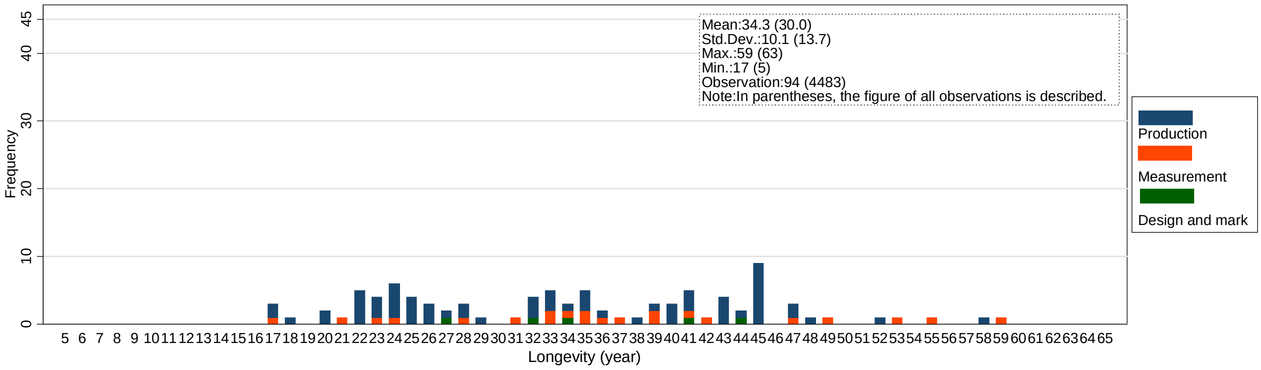
Appendix B9. Distribution of longevity (K: Chemical engineering)



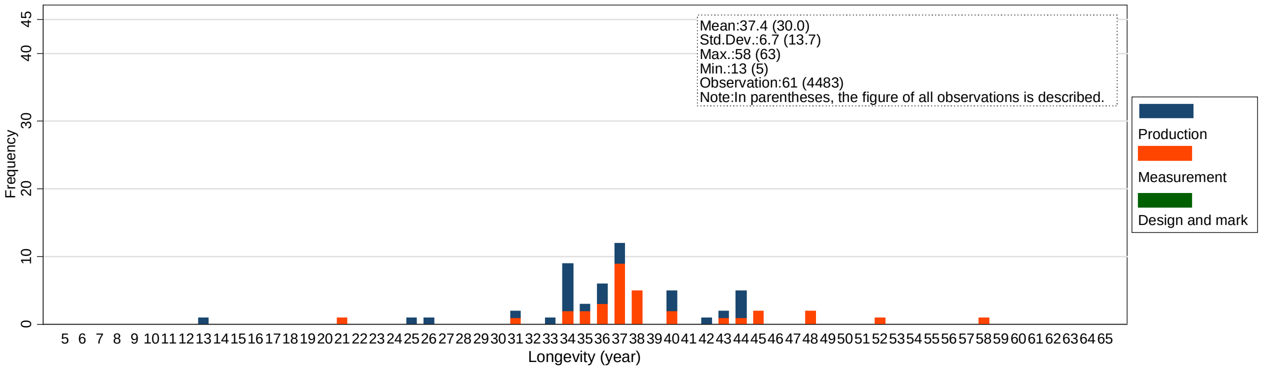
Appendix B10. Distribution of longevity (L: Textile engineering)



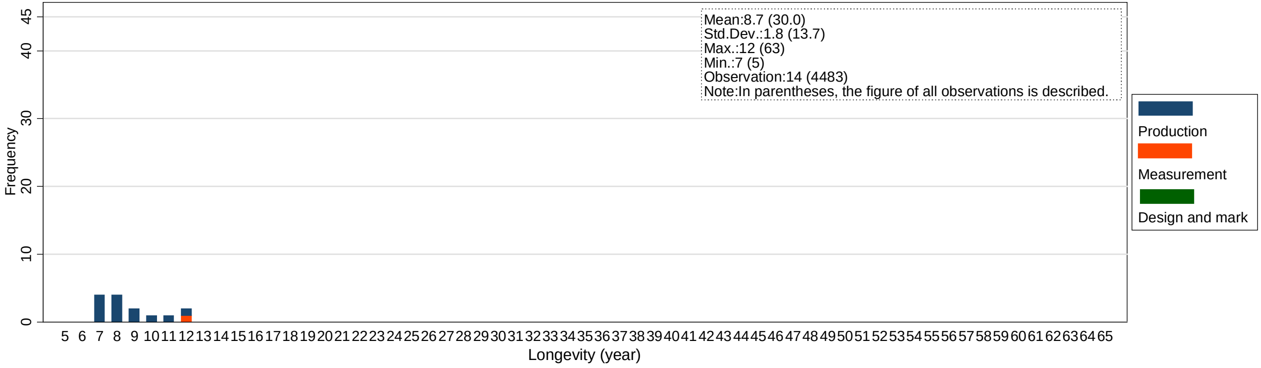
Appendix B11. Distribution of longevity (M: Mining)



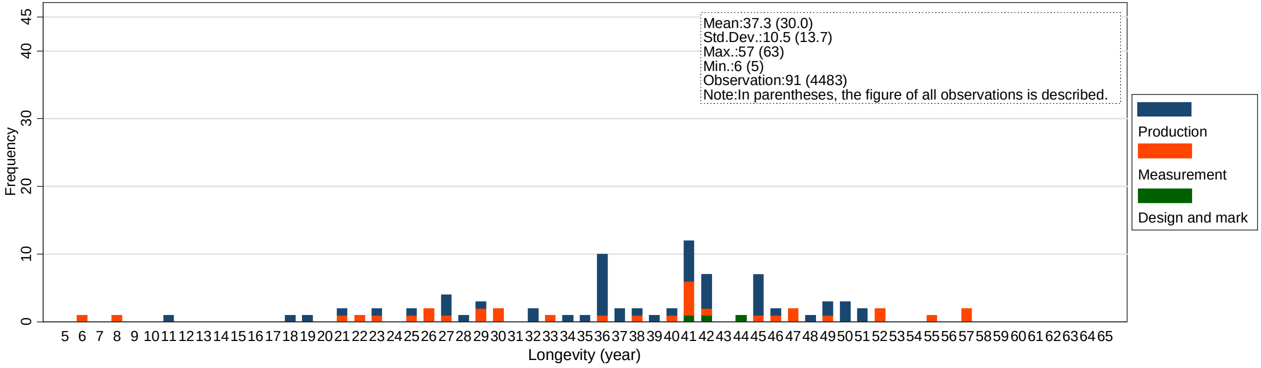
Appendix B12. Distribution of longevity (P: Pulp and paper)



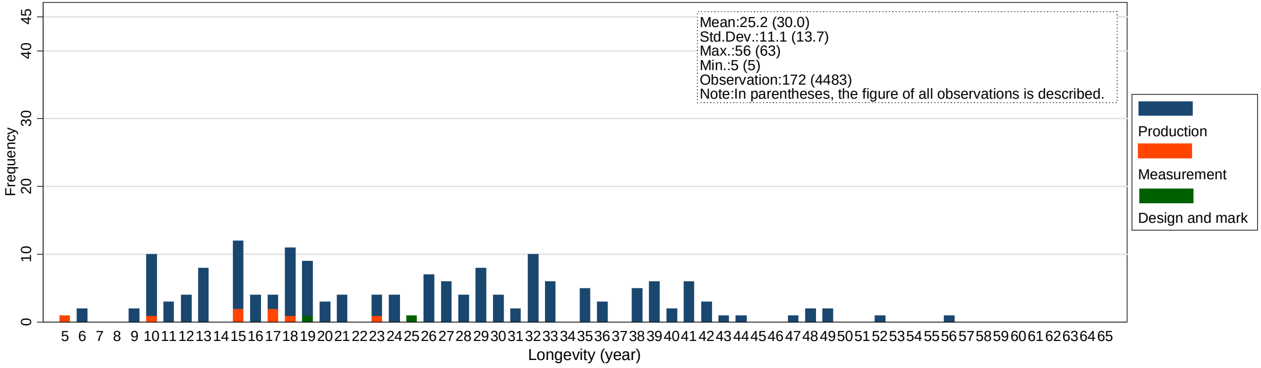
Appendix B13. Distribution of longevity (Q: Management system)



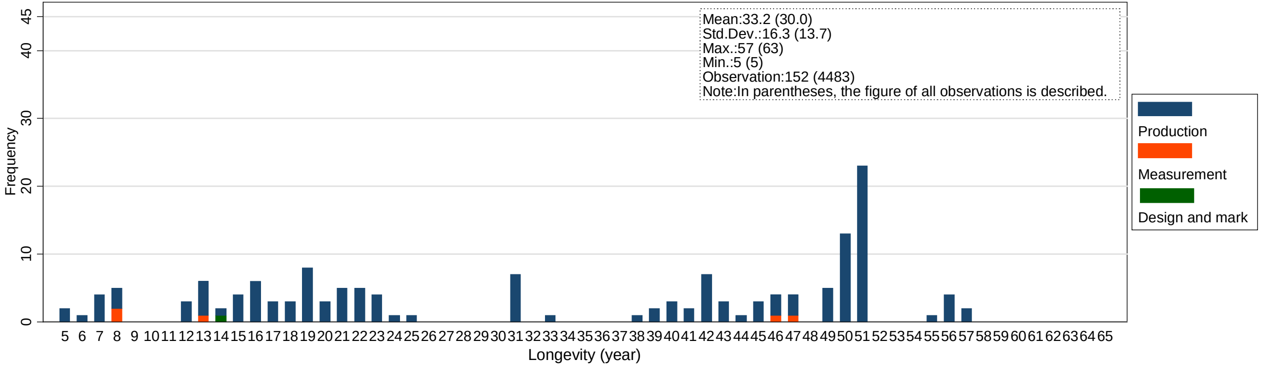
Appendix B14. Distribution of longevity (R: Ceramics)



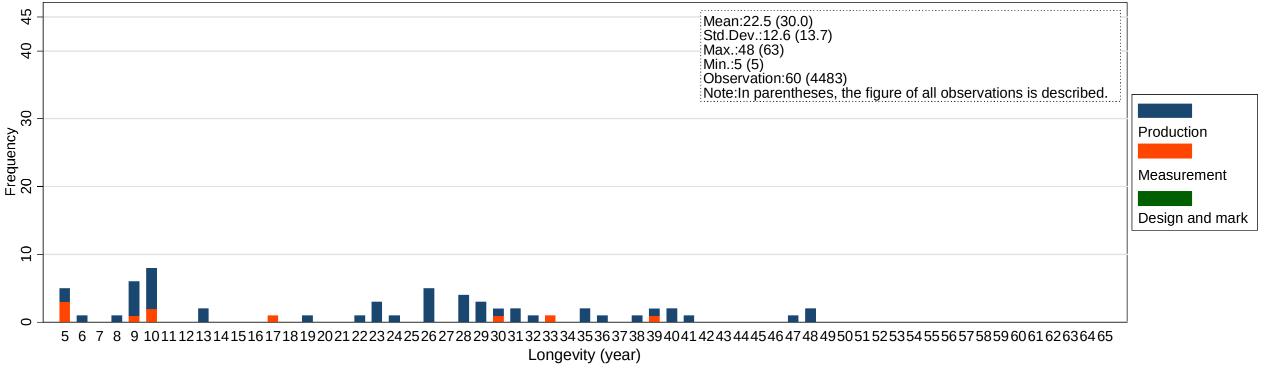
Appendix B15. Distribution of longevity (S: Domestic wares)



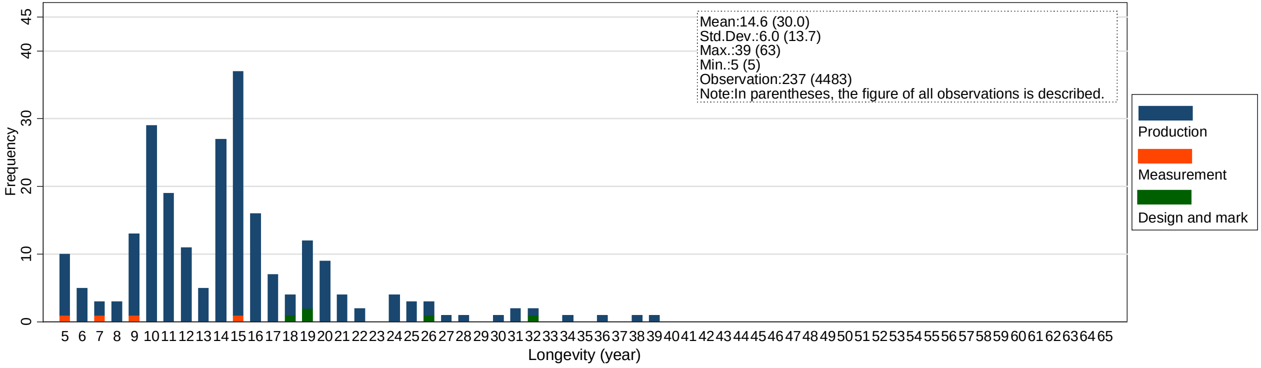
Appendix B16. Distribution of longevity (T: Medical equipment and safety appliances)



Appendix B17. Distribution of longevity (W: Aircraft and aviation)



Appendix B18. Distribution of longevity (X: Information processing)



Appendix B19. Distribution of longevity (Z: Miscellaneous)