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Research Paper

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METHODS AND TECHNIQUES OF MATERIALS MANAGEMENT IN MATERIALS SELECTION

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ABSTRACT

Material management is an approach for planning, organizing, and controlling all those activities principally concerned with the flow of materials into an organization. This paper deals with material selection during the construction process. It outlines the materials strategies considered during materials selection and it can be assessed with the help of 15 factors on a 5 point rating scale. This paper concludes with some interesting findings.

KEYWORDS: *Material management, ordering, shipping, and warehousing*

INTRODUCTION

Materials management can deal with campus planning and building design for the movement of materials, or with logistics that deal with the tangible components of a supply chain. Specifically, this covers the acquisition of spare parts and replacements, quality control of purchasing and ordering such parts, and the standards involved in ordering, shipping, and warehousing the said parts.

The goal of materials management is to provide an unbroken chain of components for production to manufacture goods on time for the customer base. The materials department is charged with releasing materials to a supply base, ensuring that the materials are delivered on time to the company using the correct carrier. Materials is generally measured by accomplishing on time delivery to the customer, on time delivery from the supply base, attaining a freight, budget, inventory shrink management, and inventory accuracy. The materials department is also charged with the responsibility of managing new launches.

In some companies materials management is also charged with the procurement of materials by establishing and managing a supply base. In other companies the procurement and management of the supply base is the responsibility of a separate purchasing department. The purchasing department is then responsible for the purchased price variances from the supply base.

In large companies with multitudes of customer changes to the final product over the course of a year, there may be a separate logistics department that is responsible for all new acquisition launches and customer changes. This logistics department ensures that the launch materials are procured for production and then transfers the responsibility to the plant materials management

Materials management is not a science and depending upon the relevance and importance that company officials place upon controlling material flow, the level of expertise changes. Some companies place materials management on a level whereby there is a logistics director, other companies see the importance level as managing at the plant level by hiring an inventory manager or materials manager, and still other companies employ the concept that the supervisors in the plant are responsible accompanied by a planners.

The major challenge that materials managers face is maintaining a consistent flow of materials for production. There are many factors that inhibit the accuracy of inventory which results in production shortages, premium freight, and often inventory adjustments. The major issues that all materials managers face are incorrect bills of materials, inaccurate cycle counts, un-reported scrap, shipping errors, receiving errors, and production reporting errors. Materials managers have striven to determine how to manage these issues in the business sectors of manufacturing since the beginning of the industrial revolution. Although there are no known methods that eliminate therefore mentioned inventory accuracy inhibitors, there are best methods available to eliminate the impact upon maintaining an interrupted flow of materials for production.

The effective materials management plan builds from and enhances an institutional master plan by filling in

the gaps and producing an environmentally responsible and efficient outcome. An institutional campus, office, or housing complex can expect a myriad of benefits from an effective materials management plan. For starters, there are long-term cost savings, as consolidating, re-configuring, and better managing a campus' core infrastructure reduces annual operating costs. An institutional campus, office, or housing complex will also get the highest and best use out of campus real estate.

An effective materials management plan also means a more holistic approach to managing vehicle use and emissions, solid waste, hazardous waste, recycling, and utility services. As a result, this means a "greener," more sustainable environment and a manifestation of the many demands today for institutions to become more environmentally friendly. In fact, thanks to such environmental advantages, creative materials management plans may qualify for LEAD Innovation in Design credits.

And finally, an effective materials management plan can improve aesthetics. Removing unsafe and unsightly conditions, placing core services out of sight, and creating a more pedestrian-friendly environment will improve the visual and physical sense of place for those who live and work there.

METHODS AND MATERIALS

This study aims at analyzing the materials management in construction companies in Tamil Nadu. It could be noted that materials management depends on many factors. In this study construction material strategies considered during material selection is examined. In this study construction companies concentrated in five regions of TamilNadu are considered as sampling frame work of the study. They are Chennai region, Madurai region, Salem region,Tiruchirapalli region and Coimbatore region. The researcher selected the 50 construction companies from each region. In total 250 construction companies are selected as sample. The relevant primary data are collected from the respondents with help of questionnaire method. The collected data are classified and tabulated with the help of computer programming. The collected data under 5 point rating scale are quantified and the data interpretations are done with the help of ANOVA test, t test and mean score.

RESULTS AND DISCUSSION

This section deals with respondents' rating on materials strategies considered during materials selection. It can be assessed with the help of 15 factors on a 5 point rating scale. These include strategic planning before procurement at design stage, procurement strategy considered for materials purchase, competence level of the workforce required for construction, the environmental impact of the materials, selection of SABS approved materials, total involvement of clients at the design stage, effects of materials cost fluctuations on cost of construction, general site organization which may affect the flow of materials on site, the level of communication between the work force during construction, availability of required materials in the market, availability of adequate materials storage facility, the sustainable nature of materials recyclable or renewable materials, materials specifications take-off from building designs, choice of building design by stakeholders and properties of the materials required for construction.

Table 1 Region Wise Respondents Rating on Materials Strategies Considered During Materials Selection

Variables	Chennai	Coimbatore	Madurai	Salem	Trichirapalli	Mean
Strategic planning before procurement at design stage	2.64	2.48	2.07	1.94	1.82	2.19
Procurement strategy considered for materials purchase	3.62	3.46	3.05	2.92	2.80	3.17
Competence level of the workforce required for construction	2.79	2.63	2.22	2.09	1.97	2.34
The environmental impact of the materials	4.02	3.86	3.45	3.32	3.20	3.57
Selection of SABS approved materials	4.15	4.09	3.88	3.65	3.73	3.90
Total involvement of clients at the design stage	2.20	2.14	1.93	1.80	1.68	1.95
Effects of materials cost fluctuations on cost of construction	3.74	3.58	3.17	3.04	2.92	3.29
General site organization which may affect the flow of materials on site	3.02	2.86	2.45	2.32	2.20	2.57
The level of communication between the workforce during construction	3.41	3.25	2.84	2.71	2.59	2.96
Availability of required materials in the market	3.14	2.98	2.57	2.44	2.32	2.69
Availability of adequate materials storage facility	4.20	4.03	3.65	3.52	3.45	3.77
The sustainable nature of materials (recyclable or renewable materials)	3.23	3.07	2.66	2.53	2.41	2.78
Materials specifications take-off from building designs	4.13	3.97	3.56	3.43	3.31	3.68
Choice of building design by stakeholders	4.19	4.10	3.98	3.90	3.83	4.00
Properties of the materials required for construction.	3.34	3.18	2.77	2.64	2.52	2.89
Average	3.45	3.31	2.95	2.82	2.72	3.05

Source : Computed from the primary data

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Variation due to materials strategies	29.015	14	2.0725	404.2776	1.872588
Variation due to regions	6.11932	4	1.52983	298.4202	2.536579
Error	0.28708	56	0.005126		
Total	35.4214	74			

Data presented in table 1 indicate the region wise respondents' rating on materials strategies considered during materials selection. It could be noted that out of the 15 materials strategies considered during materials selection, the respondents rate the choice of building design by stakeholders as their first level material strategy considered during materials selection and it is evident from their secured a mean score of 4.00 on a 5 point rating scale. Selection of SABS approved materials is rated at second level material strategy considered during materials selection and it is estimated from the respondents' secured a mean score of 3.90 on a 5 point rating scale. The respondents have material strategy considered during materials selection by citing the situation of availability of adequate materials storage facility as their third level observed event. It is evident from their secured a mean score of 3.77 on a 5 point rating scale. The respondents rank the fourth level material strategy considered during materials selection by citing the event of materials specifications take-off from building designs and it is observed from the respondents' secured a mean score of 3.68 on a 5 point rating scale. The environmental impact of the materials is rated at fifth level material strategy considered during materials selection and it could be known from the respondents' secured a mean score of 3.57 on a 5 point rating scale.

The respondents rate the effects of materials cost fluctuations on cost of construction as their rated sixth level material strategy considered during materials selection and it is revealed from their secured a mean score of 3.29 on a 5 point rating scale. Procurement strategy considered for materials purchase is rated at seventh level material strategy considered during materials selection and it observed from the respondents' secured a mean score of 3.17 on a 5 point rating scale. The respondents' rate the materials strategies considered during materials selection by citing the fact that the level of communication between the workforce during construction and it is their eighth level ranking. It is evident from their secured a mean score of 2.96 on a 5 point rating scale. The respondents hold the ninth level material strategy considered during materials selection by citing the event that properties of the materials required for construction as per their secured a mean score of 2.89 on a 5 point rating scale. The sustainable nature of materials recyclable or renewable materials is rated at tenth level material strategy considered during materials selection and it is evident from the respondents' secured a mean score of 2.78 on a 5 point rating scale.

The respondents rate the availability of required materials in the market as their eleventh level material strategy considered during materials selection and it could be known from their secured a mean score of 2.69 on a 5 point rating scale. General site organization which may affect the flow of materials on site is rated at twelfth level material strategy considered during materials selection and it is reflected from the respondents' secured a mean score of 2.57 on a 5 point rating scale. The respondents rank the thirteenth level material strategy considered during materials selection by citing the fact that competence level of the workforce required for construction. It is evident from their secured a mean score of 2.34 on a 5 point rating scale. The respondents rank the fourteenth level material strategy considered during materials selection by citing the fact that strategic planning before procurement at design stage and it is clear from their secured a mean score of 2.19 on a 5 point rating scale. Total involvement of clients at the design stage is rated at fifteenth level material strategy considered during materials selection as per the respondents' secured a mean score of 1.95 on a 5 point rating scale.

The Chennai region respondents' rank the first positions in their overall rated materials strategies considered during materials selection as per their secured a mean score of 3.45 on a 5 point rating scale. The Coimbatore region respondents' record the second position in their overall rated materials strategies considered during materials selection and it is known from their secured a mean score of 3.31 on a 5 point rating scale. The Madurai region respondents' register the third position in their overall rated materials strategies considered during materials selection and it is computed from their secured a mean score of 2.95 on a 5 point rating scale. The Salem region respondents' register the third position in their overall rated materials strategies considered during materials selection and it is computed from their secured a mean score of 2.82 on a 5 point rating scale. The Tiruchirapalli region respondents' come down to the last position in their overall rated materials strategies considered during materials selection and it is estimated from their secured a mean score of 2.72 on a 5 point rating scale.

The anova two way model is applied for further discussion. The computed anova value 404.27 is greater than its tabulated value at 5 percent level significance. Hence, the variation among the overall rated materials strategies considered during materials selection is statistically identified as significant. In another point, the computed anova value 298.42 is greater than its tabulated value at 5 percent level significance. Hence, the variation among the regions is statistically identified as significant as per the respondents rating on materials strategies considered during materials selection.

Table 2 Company Wise Respondents Rating on Materials Strategies Considered During Materials Selection

Variables	Small	Medium	Large	Mean
Strategic planning before procurement at design stage	1.97	2.12	2.38	2.19
Procurement strategy considered for materials purchase	2.95	3.10	3.46	3.17
Competence level of the workforce required for construction	2.12	2.27	2.63	2.34
The environmental impact of the materials	3.35	3.50	3.86	3.57
Selection of SABS approved materials	3.69	3.93	4.08	3.90
Total involvement of clients at the design stage	1.83	1.98	2.04	1.95
Effects of materials cost fluctuations on cost of construction	3.07	3.22	3.58	3.29
General site organization which may affect the flow of materials on site	2.35	2.50	2.86	2.57
The level of communication between the workforce during construction	2.74	2.89	3.25	2.96
Availability of required materials in the market	2.47	2.62	2.98	2.69
Availability of adequate materials storage facility	3.55	3.70	4.06	3.77
The sustainable nature of materials (recyclable or renewable materials)	2.56	2.71	3.07	2.78
Materials specifications take-off from building designs	3.46	3.57	4.01	3.68
Choice of building design by stakeholders	3.88	3.93	4.19	4.00
Properties of the materials required for construction.	2.67	2.72	3.28	2.89
Average	2.84	2.98	3.32	3.05

Source: Computed from the primary data

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Variation due to materials strategies	17.58411	14	1.256008	293.1119	2.063541
Variation due to company size	1.757684	2	0.878842	205.0936	3.340386
Error	0.119982	28	0.004285		
Total	19.46178	44			

Data presented in table 2 indicate the company wise respondents' rating on materials strategies considered during materials selection. The large size company respondents' rank the first position in expressing their overall rated materials strategies considered during materials selection as per their secured a mean score of 3.32 on a 5 point rating scale. The medium size company respondents' record the second position in rating the overall materials strategies considered during materials selection as per their secured a mean score of 2.98 on a 5 point rating scale. The small size company respondents' come down to the last position in their overall materials strategies considered during materials selection and it is evident from their secured a mean score of 2.84 on a 5 point rating scale.

The anova two way model is applied for further discussion. The computed anova value 293.11 is greater than its tabulated value at 5 percent level significance. Hence, the variation among the materials strategies considered during materials selection is statistically identified as significant. In another point, the computed anova value 205.09 is greater than its tabulated value at 5 percent level significance. Hence, the variation among the companies is statistically identified as significant as per the respondents' rating on materials strategies considered during materials selection.

Table 3 Occupation Wise Respondents Rating on Materials Strategies Considered During Materials Selection

Variables	Civil Engineer	Site Engineer	Electrical Engineer	Technicians	Contractors	Mean
Strategic planning before procurement at design stage	2.71	2.55	2.12	1.84	1.72	2.19
Procurement strategy considered for materials purchase	3.69	3.53	3.10	2.82	2.70	3.17
Competence level of the workforce required for construction	2.86	2.70	2.27	1.99	1.87	2.34
The environmental impact of the materials	4.09	3.93	3.50	3.22	3.10	3.57
Selection of SABS approved materials	4.22	4.16	3.93	3.55	3.63	3.90
Total involvement of clients at the design stage	2.17	2.11	1.98	1.80	1.68	1.95
Effects of materials cost fluctuations on cost of construction	3.81	3.65	3.22	2.94	2.82	3.29
General site organization which may affect the flow of materials on site	3.09	2.93	2.50	2.22	2.10	2.57
The level of communication between the workforce during construction	3.48	3.32	2.89	2.61	2.49	2.96
Availability of required materials in the market	3.21	3.05	2.62	2.34	2.22	2.69
Availability of adequate materials storage facility	4.21	4.10	3.76	3.42	3.35	3.77
The sustainable nature of materials (recyclable or renewable materials)	3.30	3.14	2.71	2.43	2.31	2.78
Materials specifications take-off from building designs	4.15	4.04	3.66	3.33	3.21	3.68
Choice of building design by stakeholders	4.20	4.17	4.03	3.86	3.73	4.00
Properties of the materials required for construction.	3.41	3.25	2.82	2.54	2.42	2.89
Average	3.51	3.38	3.01	2.73	2.62	3.05

Source: Computed from the primary data

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Variation due to materials strategies	17.19656	14	1.228326	194.9331	2.063541
Variation due to occupation	2.010031	2	1.005016	159.4941	3.340386
Error	0.176436	28	0.006301		
Total	19.38303	44			

Data presented in table 3 indicate the occupation wise respondents' rating on materials strategies considered during materials selection. The civil engineering group respondents rank the first position in their overall rated materials strategies considered during materials selection as per their secured a mean score of 3.51 on a 5 point rating scale. The site engineer group respondents register the second position in their overall rated materials strategies considered during materials selection as per their secured a mean score of 3.38 on a 5 point rating scale. The electrical engineer respondents record the third position in their overall rated materials strategies considered during materials selection as per their secured a mean score of 3.01 on a 5 point rating scale. The technicians group respondents record the fourth position in their overall rated materials strategies considered during materials selection as per their secured a mean score of 2.73 on a 5 point rating scale. The Contractors group respondents come down to last position in their overall rated materials strategies considered during materials selection as per their secured a mean score of 2.62 on a 5 point rating scale.

The anova two ways model is applied for further discussion. The computed anova value 194.93 is greater than its tabulated value at 5 percent level significance. Hence, the variation among the materials strategies considered during materials selection is statistically identified as significant. In another point, the computed anova value 159.49 is greater than its tabulated value at 5 percent level significance. Hence, the variation among the occupational status is statistically identified as significant as per the respondents expressed materials strategies considered during materials selection.

Table 4 Education Wise Respondents Rating on Materials Strategies Considered During Materials Selection

Variables	Research degree	Post graduate	Under graduate	Diploma	Mean
Strategic planning before procurement at design stage	2.65	2.42	1.96	1.73	2.19
Procurement strategy considered for materials purchase	3.73	3.40	2.94	2.61	3.17
Competence level of the workforce required for construction	2.70	2.57	2.11	1.98	2.34
The environmental impact of the materials	4.13	3.80	3.34	3.01	3.57
Selection of SABS approved materials	4.16	4.03	3.77	3.44	3.90
Total involvement of clients at the design stage	2.21	2.08	1.82	1.69	1.95
Effects of materials cost fluctuations on cost of construction	3.85	3.52	3.06	2.73	3.29
General site organization which may affect the flow of materials on site	3.13	2.80	2.34	2.01	2.57
The level of communication between the workforce during construction	3.52	3.19	2.73	2.40	2.96
Availability of required materials in the market	3.25	2.92	2.46	2.13	2.69
Availability of adequate materials storage facility	4.23	4.10	3.54	3.21	3.77
The sustainable nature of materials (recyclable or renewable materials)	3.34	3.01	2.55	2.22	2.78
Materials specifications take-off from building designs	4.20	3.91	3.45	3.16	3.68
Choice of building design by stakeholders	4.24	4.15	3.97	3.64	4.00
Properties of the materials required for construction.	3.45	3.12	2.66	2.33	2.89
Average	3.52	3.27	2.85	2.55	3.05

Source: Computed from the primary data

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*Fcrit*
Variation due to materials strategies	22.88133	14	1.634381	160.5232	1.935009
Variation due to education	8.346573	3	2.782191	273.2571	2.827049
Error	0.427627	42	0.010182		
Total	31.65553	59			

Data presented in table 4 indicate the education wise respondents' rating on materials strategies considered during materials selection. The research degree level educated respondents rank the first position in their overall rated materials strategies considered during materials selection as per their secured a mean score of 3.52 on a 5 point rating scale. The post graduate degree holder respondents register the second position in their overall rated materials strategies considered during materials selection as per their secured a mean score of 3.27 on a 5 point rating scale. The under graduate degree holder respondents rank the first position in their overall rated materials strategies considered during materials selection as per their secured a mean score of 2.85 on a 5 point rating scale. The diploma holder respondents come down to last position in their overall rated materials strategies considered during materials selection as per their secured a mean score of 2.55 on a 5 point rating scale.

The anova two ways model is applied for further discussion. The computed anova value 160.52 is greater than its tabulated value at 5 percent level significance. Hence, the variation among the materials strategies considered during materials selection is statistically identified as significant. In another point, the computed anova value 273.25 is greater than its tabulated value at 5 percent level significance. Hence, the variation among the educational status is statistically identified as significant as per the respondents expressed materials strategies considered during materials selection.

Table 5 Company Duration Wise Respondents Rating on Materials Strategies Considered During Materials Selection

Variables	5-10 years	10-15 years	15-20 years	20-25 years	Above 25 years	Mean
Strategic planning before procurement at design stage	1.81	2.03	2.18	2.35	2.58	2.19
Procurement strategy considered for materials purchase	2.69	3.01	3.16	3.33	3.66	3.17
Competence level of the workforce required for construction	2.06	2.18	2.33	2.50	2.63	2.34
The environmental impact of the materials	3.09	3.41	3.56	3.73	4.06	3.57
Selection of SABS approved materials	3.52	3.84	3.89	3.96	4.09	3.90
Total involvement of clients at the design stage	1.81	1.89	1.94	2.01	2.10	1.95
Effects of materials cost fluctuations on cost of construction	2.81	3.13	3.28	3.45	3.78	3.29
General site organization which may affect the flow of materials on site	2.09	2.41	2.56	2.73	3.06	2.57
The level of communication between the workforce during construction	2.48	2.80	2.95	3.12	3.45	2.96
Availability of required materials in the market	2.21	2.53	2.68	2.85	3.18	2.69
Availability of adequate materials storage facility	3.29	3.61	3.76	4.03	4.16	3.77
The sustainable nature of materials (recyclable or renewable materials)	2.30	2.62	2.77	2.94	3.27	2.78
Materials specifications take-off from building designs	3.24	3.52	3.67	3.84	4.13	3.68
Choice of building design by stakeholders	3.72	4.04	3.99	4.08	4.17	4.00
Properties of the materials required for construction.	2.41	2.73	2.88	3.05	3.38	2.89
Average	2.64	2.92	3.04	3.20	3.45	3.05

Source: Computed from the primary data

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Rows	28.68247	14	2.048748	245.0376	1.872588
Columns	5.535587	4	1.383897	165.519	2.536579
Error	0.468213	56	0.008361		
Total	34.68627	74			

Data presented in table 5 indicate the company duration wise respondents' rating on materials strategies considered during materials selection. The respondents belong to the above 25 years company duration group rank the first position in their overall rated materials strategies considered during materials selection as per their secured a mean score of 3.45 on a 5 point rating scale. The respondents come under the company duration in the rank of 20-25 years experience group register the second position in their overall rated materials strategies considered during materials selection as per their secured a mean score of 3.20 on a 5 point rating scale. The respondents included in the company duration group 15-20 years age occupy the third position in their overall rated materials strategies considered during materials selection as per their secured a mean score of 3.04 on a 5 point rating scale. The respondents included in the 10-15 company duration group occupy the fourth position in their overall rated materials strategies considered during materials selection as per their secured a mean score of 2.92 on a 5 point rating scale. The respondents observed in the 5-10 years company duration group come down to last position in their overall rated materials strategies considered during materials selection as per their secured a mean score of 2.64 on a 5 point rating scale.

The anova two way model is applied for further discussion. The computed anova value 245.03 is greater than its tabulated value at 5 percent level significance. Hence, the variation among the materials strategies considered during materials selection is statistically identified as significant. In another point, the computed anova value 165.51 is greater than its tabulated value at 5 percent level significance. Hence, the variation among the company duration is statistically identified as significant as per the respondents expressed materials strategies considered during materials selection.

CONCLUSION

It could be seen clearly from the above discussion that the respondents' have high level materials strategies considered during materials selection by citing the indicators of choice of building design by stakeholders, selection of SABS approved materials, availability of adequate materials storage facility, materials specifications take-off from building designs and the environmental impact of the materials as per their secured a mean score above 3.50 on a 5 point rating scale. The respondents' report the moderate level materials strategies considered during materials selection by stating the facts that effects of materials cost fluctuations on cost of construction, procurement strategy considered for materials purchase, the level of communication between the work force during

construction, properties of the materials required for construction, the sustainable nature of materials recyclable or renewable materials, availability of required materials in the market and general site organization which may affect the flow of materials on site as per their secured a mean score in the range of 2.50 to 3.50 on a 5 point rating scale. The respondents' rate the low level materials strategies considered during materials selection by indicating facts that competence level of the workforce required for construction, strategic planning before procurement at design stage and total involvement of clients at the design stage as per their secured a mean score below 2.50 on a 5 point rating scale. It could be observed that the Chennai region respondents' rank the first position in their rated overall materials strategies considered during materials selection, Coimbatore region respondents' the second, Madurai region respondents' the third, Salem region respondents' the fourth and Tiruchirapalli region respondents' the last.

It could be seen clearly from the above discussion that the large size company respondents' rank the first position in their overall rated materials strategies considered during materials selection, medium size company respondents the second and small size company respondents' the last.

The result of occupation wise analysis reveals that the civil engineer group respondents rank the first position in their overall rated materials strategies considered during materials selection, site engineer group respondents the second, electrical engineer group respondents the third, technicians group respondents the fourth and contractors group respondents the last.

The result of education wise analysis reveals that the research degree level educated respondents rank the first position in their overall rated materials strategies considered during materials selection, post graduate degree holder respondents the second, under graduate degree holder respondents the third and diploma holder respondents the last.

The result of company duration wise analysis reveals that the respondents belong to the company duration above 25 years experience group rank the first position in their overall rated materials strategies considered during materials selection, respondents come under the 20-25 years company duration group the second, respondents identified in the 15-20 years company duration group the third, respondents come under the 10-15 years company duration group the fourth and respondents observed in the 5-10 years company duration group the last.

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