FORECASTING GOODS VOLUMES OF SIXTEEN LARGE LOGISTICS PROVIDERS OVER THE WORLD

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ABSTRACT

Logistics providers (LPs) propose a service to support delivering products via ocean, air, road, i.e that demands for exchanging trade process. In recent years, totals goods join into trade operation which are being increased. For presenting the amount of product volumes by air and sea mode in the future time, the study uses Holt's linear trend models in Tableau for predicting goods volumes of 16 large logistics providers all over the world during the period 2018–2022. Based on the indicator of mean absolute percentage error (MAPE), the additive trend model with the average value as 7.83% proposes a high accuracy forecast data. The empirical results foresee the future status of LPs, simultaneously describe an operating pathway of LPs from past to future.

Keywords: logistics provider; Holt's linear trend models; Tableau; mean absolute percentage error.

INTRODUCTION

Extending manufacturing and business trade is a foundation to enhance a development of logistics service. Hence, logistics companies are established and grow sharply all over the world. LPs consider a good central service when they always meet with the criteria such as right time, right place, high quality, lower inventory, and so on [1]. The transportation process by air freight and sea freight are shown in Figure 1. The products are packed at supplier, they are loaded on the container and transported to bonded warehouse via each of mode. At the bonded warehouse with both of exporting point and importing point, the custom will check products. If the goods are right as declaration notification, they will deliver to customer, and they will be moved back to supplier when custom detects any errors.

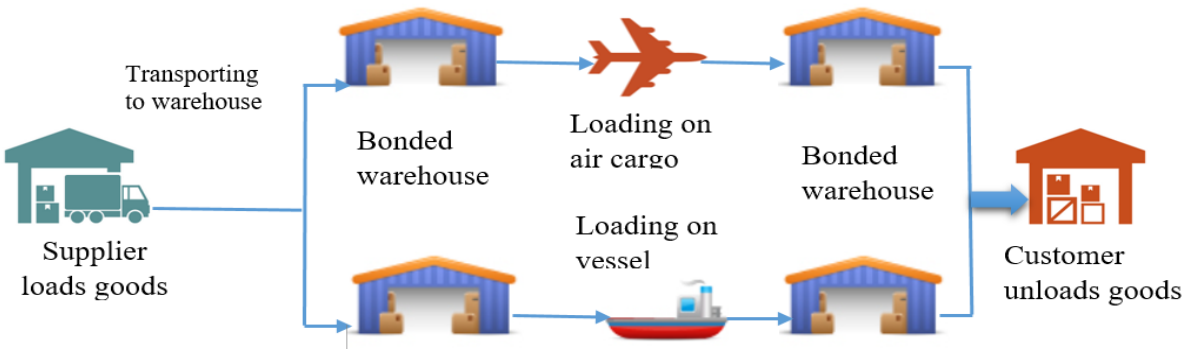

Figure 1.Logistics process

The statistics of volumes via air freight and sea freight of sixteen large LPs in future term of 2018–2022 are recommended in the research by Holt's linear trend models. The prediction results indicates the effective operation of LPs in future time.

LITERATURE REVIEW

Handling shipments deliver from original point to consumption point to be an essential flow in business of enterprises because LPs are representatives of customers in order to manage goods in physical flow including products, network information, warehousing, transportation, security functions [2]. All of packages must have labels, hazardous goods such as solids, liquids, gases must have a special note of dangerous goods [3] before LPs handle them. When packages are collected to the cargo, they will be moved by air, sea, or land by basing on the weight, volume, type of product, and destination. In annual conference, Council of Logistics Management [4] indicated that "Logistics is that part of the supply chain process that plans, implements, and control the efficient, effective flow and storage of goods, services, and related information from point of original to point of consumption in order to meet customer's requirement." As a consequence, LPs are growing up to demand for delivering goods. In particularly, Guangshu Xu used grey prediction model for estimating agricultural products logistics [5], or Qiu Ying utilized power model and linear model to forecast regional logistics [6]. In the study, Holt's linear trend models in Tableau are applied into predicting goods volumes by air mode, and sea mode of 16 large LPs over the world.

Holt's linear trend models are integrated into Tableau being models with a trend without seasonality that Holt (1957) [7] expanded simple exponential smoothing. Linear trend is a straight line along with several points of time-series values. Both additive model and multiplicative model in Holt's linear trend models are shown in this case, they have common points for prediction of time-series such as checking quality metric and smoothing coefficients [8]. The prediction values are computed by depending on the historical time-series data.

METHODOLOGY

Data collection

Based on the data of ocean and air volumes from 2012 to 2017 that posted on logisticsmgmt [9, 10], scmr [11], tla [12], and ttnews [13] the research selected 16 large LPs as shown in Table 1.

Table 1. Large LPs over the world

No	Company	No	Company
1	Yusen Logistics	9	Hellmann
2	UPS	10	GEODIS
3	Toll Group	11	Expeditors
4	Panalpina	12	DSV
5	Nippon Express	13	DHL
6	Logwin	14	CEVA Logistics
7	Kuehne + Nagel	15	C.H. Robinson
8	Kerry Logistics	16	Agility

Holt's linear trend model

Tableau is an analysis tool with big data, data visualization, i.e. In this study, the researcher demands to predict the data based on the time-series that integrates the exponential smoothing methods with trend level but no seasonality.

Let X (X_t, X_{t+1}, …, X_{t+s}) as the primary time-series of large logistics providers, then P (P_t, P_{t+1}, …, P_{t+n}) as their forecasting value, whereas t presents the time of each time, s is the number of periods in actual time, and n is the number of periods in the forecast lead-time. The consequence of formulation for actual time and prediction time starts at point t equaling 0. Thus, the mathematical model of primary simple exponential smoothing with the level of smoothing coefficient as α, but no trend is set up as below:

$$\begin{gathered} P_0 = X_0 \\ P_t = \alpha * X_t + (1-\alpha) * P_t \\ (0 \le \alpha \le 1) \end{gathered} \tag{1}$$

Accompanied by Holt (1957) [7], the study also uses an extended method of the simple exponential smoothing with a trend in Tableau that expresses prediction data including one for the level as α, and one for the trend like β. Thus, the equation is utilized to compute the forecasting data in two cases as following:

In the additive trend model, the estimated value is calculated with the smoothed additive trend at the end of period t (A_t) as below:

$$\begin{gathered} X_t = \alpha P_t + (1-\alpha)(X_{t-1} + A_{t-1}) \\ A_{t-1} = \beta(X_t - X_{t-1}) + (1-\beta)A_{t-1} \\ \hat{P}_t(n) = X_t + nA_t \\ (0 \le \alpha, \beta \le 1) \end{gathered} \tag{2}$$

In the multiplicative trend model, the forecasting value is formulated with the smoothed multiplicative trend at the end of period t (M_t) as below:

$$\begin{gathered} X_t = \alpha P_t + (1-\alpha)(X_{t-1} M_{t-1}) \\ M_{t-1} = \beta\left({}^{X_t}/_{X_{t-1}}\right) + (1-\beta)M_{t-1} \\ \widehat{P_t}(n) = X_t M_t^n \\ (0 \le \alpha, \beta \le 1) \end{gathered} \tag{3}$$

The predicted result is rechecked by MAPE index in order to make sure an accuracy level, the equation is given as following:

$$MAPE = \frac{100}{n}\sum_{t=1}^{n}\left|\frac{X_t - P_t}{X_t}\right| \tag{4}$$

The classification of MAPE is given in the Table 2.

Table 2. Indication of MAPE

Quality metrics	Units
excellent	smaller than 10%
good	10% to 20%
reasonable	20% to 50%
unacceptable	higher than 50%

Table 2 exhibits the classification of MAPE indicator. The forecasting data will have an excellent value, as its MAPE is smaller than 10%; a good valuation if the MAPE is from 10% to 20%; a reasonable

valuation when the MAPE is from 20% to 50%; and an unacceptable if the MAPE is under 50%. Thus, the data or model must be reselected if the future data receive an unacceptable MAPE.

RESULTS

According to the list of 16 large LPs over the world during the period of 2012–2017 in data collection, the historical data of 16 large LPs from 2012 to 2017 are collected and described as shown in Table A1–2. The study applies historical time-series of volumes into Holt's linear additive model in Tableau to predict the future time of 2018–2022.

Forecasting values

For making accuracy prediction data, their forecasting values will be tested by parameters of alpha, and beta because they unveil the reliability level of estimated values. Table A3 denotes that the alpha, and beta parameters get quality under their space condition from 0 to 1. The minimum unit is 0, and the maximum unit is 0.5.

Table 3. MAPE index of 16 large logistics providers

Company	Additive level and trend model		Multiplicative level and trend model	
	Air Metric Tons	Ocean TEUs	Air Metric Tons	Ocean TEUs
Yusen Logistics	4.80%	8.30%	4.80%	8.40%
UPS	3.80%	8.80%	3.90%	8.90%
Toll Group	4.30%	3.70%	4.30%	3.60%
Panalpina	4.10%	4.60%	4.10%	4.60%
Nippon Express	6.20%	16.20%	6.10%	15.90%
Logwin	4.20%	4.40%	4.20%	4.50%
Kuehne + Nagel	3.40%	3.60%	3.40%	3.60%
Kerry Logistics	1.20%	11.40%	1.20%	11.60%
Hellmann	10.00%	7.90%	10.20%	8.20%
GEODIS	11.70%	18.30%	11.80%	18.20%
Expeditors	4.70%	5.30%	4.80%	5.30%
DSV	30.80%	19.50%	31.20%	19.50%
DHL	2.80%	10.80%	2.80%	10.70%
CEVA Logistics	4.60%	5.50%	4.70%	5.40%
C.H. Robinson	5.30%	3.70%	5.40%	3.70%
Agility	7.30%	9.30%	7.10%	9.30%
Average	7.83%		7.86%	

Besides, the MAPE index rechecks the prediction results. Table 3 shows the MAPE classification of additive trend model, and multiplicative trend model. In the air mode, the additive level and trend method has fourteen providers that get an excellence prediction with the indication under 10%, except Geodis achieves a good forecast with the index 11.70%, and DSV is only at the reasonable level with the index

30.80%. The multiplicative level and trend method has thirteen large logistics providers attains an excellence forecast when their indicators are under 10%, Hellmann and Geodis get a good prediction when their MAPEs are 10.20%, 11.80%, respectively, and DSV only has a reasonable forecast because its indication is 31.20%. In the ocean mode, for two methods, there are eleven large logistics providers with the excellent forecast when their values are under 10%. And Nippon Express, Kerry Logistics, Geodis, DSV and DHL get a good estimated data, their indicators in the additive level and trend method are 16.20%, 11.40%, 18.30%, 19.50%, and 10.80%, respectively; their indicators in the multiplicative level and trend method are 15.90%, 11.60%, 18.20%, 19.50%, and 10.70%, respectively. As consequence, all indicators of two models have a reasonably qualification when they obtain from 1.20% to 31.20%. The average percentages of additive trend model and multiplicative trend model are 7.83%, 7.86%, respectively. As a result, the additive trend model is stronger than the multiplicative, these accuracy prediction values via the additive trend model in Tables A4–5 are utilized to analyze the operation process of 16 large logistics providers from past to future.

Operation process analysis

Tableau presents not only forecasting values by number but also an integration of chart in which describes a visualization of the operation process of 16 large logistics provider. Each of provider in actual term and estimated term is marked by a separate color. As shown in Figures 2–3, they express their volumes in the operation process from previous time to future time.

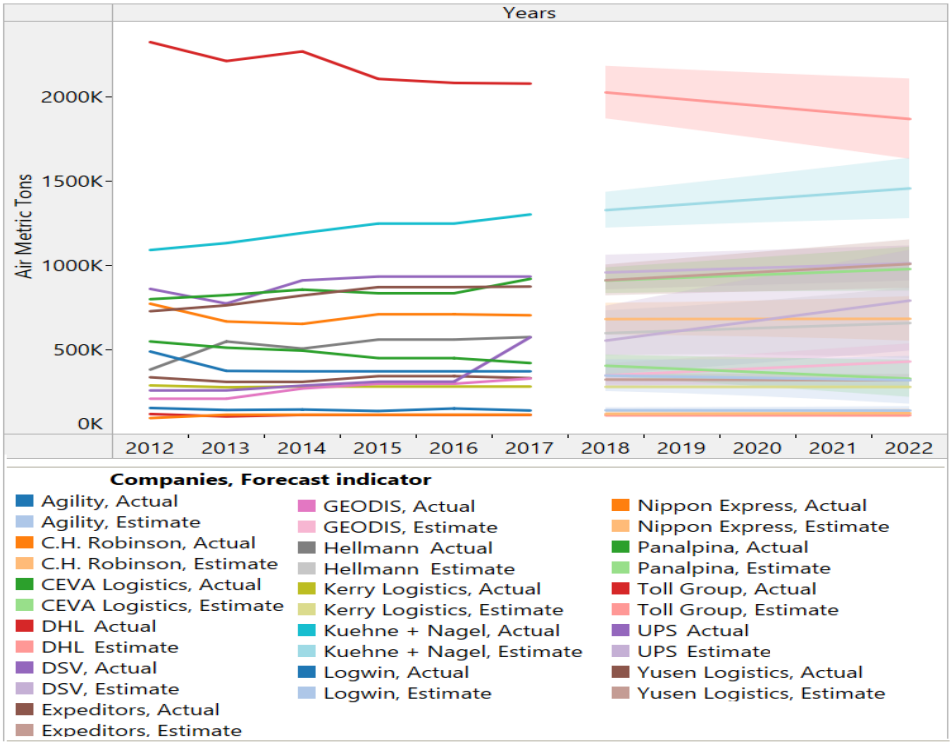

Figure 2. Operation process of 16 large LPs by air mode.

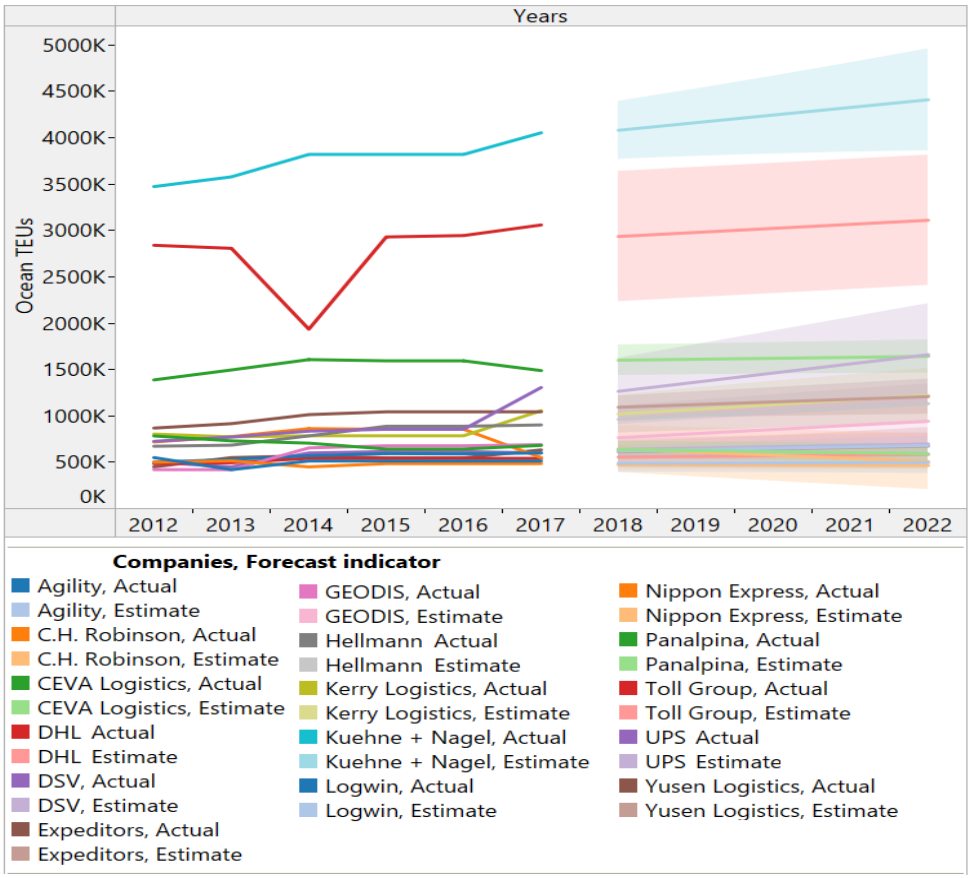

Figure 3. Operation process of 16 large LPs by sea mode.

Observing the trend line of air mode and sea mode in Figures 2–3, the empirical results denote that most of them have a fluctuation for each of LPs during the period term of 2012–2022. Agility kept a stable within 3 years from 2012 to 2014, then was down consecutively. Ceva is a unique LP that its' volumes for air mode and sea mode are reduced in whole term. C.H Robinson obtains extending in air freight but its' ocean freight is fluctuated, especially the volumes in future term can drop. Hellman, Kerry logistics, Logwin, and Toll group get a risen efficiency in ocean freight, besides, their air freight are been fluctuated. Nippon, Panalpina, UPS, Yusen, and DHL are logistics which have a consecutive fluctuation in whole term. However, DSV, Expeditor, Geodis, and Kuehne obtain upward trend smoothly in each year. DHL always has a highest volume in whole term, and the volume of Kuehne ranks at the second position.

CONCLUSION

A visualization of 16 large LPs over the world from past to future are described an upward and downward line of total volumes in operation process. Whereas, the total volumes in future time are formulated by Holt's linear trend model via basing on historical time-series, the accuracy prediction values during the period of 2018–2022 are computed by additive trend model. This study presents a forecast data of the air and ocean volumes in order to give a foreseen in the future. Moreover, the research describes a high accuracy methods in Tableau to predict the future based on historical data.

APPENDIX

Table A1. Historical data via air mode from 2012 to 2017

Company	2012	2013	2014	2015	2016	2017
Agility	490000	375000	372700	372700	372700	372700
C.H. Robinson	95000	115000	115000	115000	115000	115000
CEVA Logistics	550000	513000	495600	451000	451000	421800
DHL	2327000	2215000	2272000	2109000	2085000	2081000
DSV	259057	259365	287662	311193	311193	574644
Expeditors	729527	764376	823094	872480	872480	875914
GEODIS	210000	210000	270600	299032	299032	330000
Hellmann	383194	549948	507361	561240	561240	576225
Kerry Logistics	289000	278000	282200	282200	282200	282200
Kuehne + Nagel	1093000	1134000	1194000	1250000	1250000	1304000
Logwin	155000	143000	146000	137000	152000	140000
Nippon Express	773773	668522	654101	711354	711354	705478
Panalpina	801000	825100	858000	836200	836200	921400
Toll Group	119000	104740	114000	114000	114000	114000
UPS	862000	775000	912500	935300	935300	935300
Yusen Logistics	337130	310000	310000	344000	344000	332389

Table A2. Historical data via ocean mode from 2012 to 2017

Ocean TEUs	2012	2013	2014	2015	2016	2017
Agility	550000	420000	513500	513500	513500	513500
C.H. Robinson	500000	515000	450000	485000	485000	485000
CEVA Logistics	783378	730750	705900	642370	642370	681600
DHL	2840000	2807000	1935000	2930000	2945000	3059000
DSV	725806	772142	835487	855319	855319	1305594
Expeditors	868487	916168	1013478	1043880	1043880	1044116
GEODIS	420000	420000	654500	677465	677465	690000
Hellmann	672569	684156	784329	888284	888284	902260
Kerry Logistics	804000	774000	785600	785600	785600	1055600
Kuehne + Nagel	3473000	3578000	3820000	3820000	3820000	4053000
Logwin	500000	530000	570000	593000	590000	600000
Nippon Express	719052	776576	862753	855002	855002	550000
Panalpina	1388000	1495400	1607000	1593900	1593900	1488500
Toll Group	484000	494493	542000	542000	542000	542000
UPS	500000	450000	600000	615000	615000	600000
Yusen Logistics	450000	550000	570000	547000	547000	633056

Table A3. Smoothing coefficient

Company	Additive level and trend model				Multiplicative level and trend model			
	Air Metric Tons		Ocean TEUs		Air Metric Tons		Ocean TEUs	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta
Yusen Logistics	0.119	0	0.327	0.5	0.12	0	0.334	0.5
UPS	0.061	0.14	0.104	0.321	0.061	0.336	0.1	0.456
Toll Group	0.176	0.5	0.249	0.324	0.175	0.5	0.216	0.4
Panalpina	0.5	0.15	0.092	0.5	0.5	0.161	0.097	0.5
Nippon Express	0.211	0.5	0.329	0	0.209	0.5	0.293	0
Logwin	0.248	0.5	0.5	0.122	0.246	0.5	0.5	0.133
Kuehne + Nagel	0.5	0.138	0.5	0.173	0.5	0.147	0.5	0.181
Kerry Logistics	0.227	0.5	0.5	0	0.226	0.5	0.5	0
Hellmann	0.265	0.5	0.5	0.034	0.274	0.5	0.5	0.057
GEODIS	0.5	0.074	0.376	0.092	0.5	0.107	0.263	0.301
Expeditors	0.5	0.083	0.5	0.079	0.5	0.095	0.386	0.184
DSV	0.5	0.026	0.5	0.071	0.5	0.093	0.5	0.116
DHL	0.446	0.115	0	0.449	0.448	0.1	0	0.449
CEVA Logistics	0.5	0.152	0.169	0.417	0.5	0.14	0.191	0.284
C.H. Robinson	0.244	0.5	0.041	0.5	0.248	0.5	0.039	0.5
Agility	0.244	0.5	0.149	0.5	0.237	0.5	0.149	0.5

Table A4. Forecasting values during the period of 2018–2022

Company	Year	Air Mtons	Ocean TEUs	Company	Year	Air Mtons	Ocean TEUs
Agility	2018	347534	489214	Kerry Logistics	2018	280453	1020405
Agility	2019	340609	490724	Kerry Logistics	2019	280329	1070725
Agility	2020	333684	492234	Kerry Logistics	2020	280204	1121045
Agility	2021	326759	493743	Kerry Logistics	2021	280080	1171365
Agility	2022	319834	495253	Kerry Logistics	2022	279955	1221685
C.H. Robinson	2018	119302	471961	Kuehne + Nagel	2018	1329702	4080201
C.H. Robinson	2019	120456	469860	Kuehne + Nagel	2019	1361948	4162502
C.H. Robinson	2020	121610	467760	Kuehne + Nagel	2020	1394194	4244803
C.H. Robinson	2021	122764	465659	Kuehne + Nagel	2021	1426440	4327105
C.H. Robinson	2022	123918	463558	Kuehne + Nagel	2022	1458686	4409406
CEVA Logistics	2018	405720	638166	Logwin	2018	141280	620887
CEVA Logistics	2019	386555	626032	Logwin	2019	140903	635924
CEVA Logistics	2020	367390	613898	Logwin	2020	140526	650960
CEVA Logistics	2021	348225	601763	Logwin	2021	140150	665996
CEVA Logistics	2022	329061	589629	Logwin	2022	139773	681032
DHL	2018	2028416	2934600	Nippon Express	2018	682837	642921
DHL	2019	1989023	2978400	Nippon Express	2019	683252	609111
DHL	2020	1949629	3022200	Nippon Express	2020	683668	575300

Table A5. Forecasting values during the period of 2018–2022 (Continue)

DHL	2021	1910236	3066000	Nippon Express	2021	684084	541490
DHL	2022	1870842	3109800	Nippon Express	2022	684500	507680
DSV	2018	555226	1264710	Panalpina	2018	911287	1600243
DSV	2019	614533	1363458	Panalpina	2019	928460	1610578
DSV	2020	673840	1462206	Panalpina	2020	945633	1620912
DSV	2021	733147	1560954	Panalpina	2021	962806	1631247
DSV	2022	792454	1659701	Panalpina	2022	979980	1641582
Expeditors	2018	913297	1092701	Toll Group	2018	111633	555933
Expeditors	2019	937467	1121415	Toll Group	2019	111788	562795
Expeditors	2020	961636	1150129	Toll Group	2020	111944	569657
Expeditors	2021	985805	1178843	Toll Group	2021	112099	576519
Expeditors	2022	1009975	1207556	Toll Group	2022	112254	583381
GEODIS	2018	348573	764742	UPS	2018	959750	637692
GEODIS	2019	369127	809033	UPS	2019	973270	652531
GEODIS	2020	389682	853323	UPS	2020	986789	667369
GEODIS	2021	410236	897614	UPS	2021	1000309	682208
GEODIS	2022	430791	941905	UPS	2022	1013829	697046
Hellmann	2018	599272	962008	Yusen Logistics	2018	323551	612186
Hellmann	2019	614314	1004613	Yusen Logistics	2019	322603	627269
Hellmann	2020	629357	1047217	Yusen Logistics	2020	321655	642353
Hellmann	2021	644399	1089822	Yusen Logistics	2021	320707	657436
Hellmann	2022	659442	1132426	Yusen Logistics	2022	319758	672520

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