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IMPROVEMENT OF UKRAINIAN INDUSTRIAL COMPANY'S PERFORMANCE DIAGNOSTICS BASED ON ITS LOGISTIC SYSTEM ANALYSIS

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Abstract

In the competitiveness environment on external and internal markets the more important role now can be given to company's organizational features and leverages as a set of tools that can work out the best solution to improve enterprise's performance in general. The study aims to create a model of industrial company's performance diagnostics based on evaluating firm's external flows by taking into consideration its financial, marketing, producing and logistic indicators at once. The objective is to divide industrial enterprises into specified groups by statistics cluster analysis in order to diagnose similarities within each group and develop management key-points recommendations to each of the group depending on their logistic system condition.

Keywords: industrial company's performance, cluster analysis, company's external flows diagnostics

JEL classification: M210, O1, O160

1. INTRODUCTION

Internalisation of world's economy and diminishing frontiers for international activities of enterprises give a lot of opportunities to firms on one hand and may cause crucial effects as low quality production, non-competitive goods stock at warehouse and bankruptcy in the long term on the other. In order to profit only the bright side of world globalization trends companies have to search for new methods of organizing their business activities. Company's performance from the point of view of its management system can be evaluated by two criteria: its internal process and external flows effectiveness on the market. The aim of this paper is to sketch Ukrainian industrial enterprises in clusters by examining their external flows at the level of their financial, marketing, producing and logistic indicators and develop management key-points recommendations to each of the group.

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The study objectives in the respect of presented aim are: 1) to scrutinize existing approaches in industrial company performance diagnostics, 2) to investigate the procedure of cluster analysis implementation, 3) to conduct Ukrainian industrial companies performance diagnostics, 4) to develop management key-points recommendations to each formed cluster.

2. LITTERATURE REVIEW

The literature survey defined different approaches to company's performance evaluation. Theoretical models of solving this type of problems are connected with analysing common or specified data for research. Commonly used the approach of estimating financial position of a company by identifying its financial coefficients state based on data of balance sheet and consolidated company's financial statement (Litovchenko and Golovko, 2012; Tkachova, 2012, p. 39). This type of methods is frequently used due to accessibility the primary data. At the same moment there is another method if the researcher's aim is to take into consideration not only quantitative but also qualitative information, in this case the diagnostics procedure is usually accompanied by interviewing top-managers of an enterprise in order to gain some managerial inside information connected to quality of production, competitor's and own market share and so on (Litovchenko and Golovko, 2012). Different approaches could be classified due to general criterion for evaluation: financial state, economic efficiency, level of competitiveness, aggregated indicator, and business process intensity, strategic system leverage (Table 1).

The problem of evaluating industrial company state needs the modifying scale of variables that can be used to characterize specific segments in order to develop set of tools for improving their market position. While observing existing scientific surveys the authors realized that for working out appropriate recommendations and solutions for companies it is not sufficient to use already existed scales and variables because commonly used approaches couldn't investigate industrial company's external flow components all at once. So, we suggest to compose a model that may estimate financial, material and information parts of external flow of industrial enterprise and scrutinize their mutual influence on dependent variable return on logistic costs as a criterion for enterprise logistic system efficiency in order to group the enterprises into unions with similar characteristics. The research hypotheses are:

H1: Enterprises with the common duration of operating cycle (OC) and level of logistics return (ROLI), implement the same strategy on the market,

H2: There are several types of industrial company's behaviour on the market and it can be measured and predicted by cluster analysis,

H3: Diminishing of Duration of Financial cycle (FC) and increasing Return on Logistic Costs (ROLI) can improve industrial company's market position,

H4: Company's external flow performance due to its components (ROS – the indicator of market activities(the indicator of external information flow) , Duration of Financial cycle (FC) – the financial terms indicator, Duration of operating cycle (OC) – as an indicator of material flow of enterprise) had two way influence on its general logistic system criterion – Return on Logistic Costs (ROLI).

Table no. 1 – Generalized approaches to company's performance diagnostics

Criterion for evaluation	Key-indicator	Company's state	Author
Financial state	Altman's model of company's bankruptcy	Crisis	Guseva (2009)
		Pre-crisis	
		Normal	
		Ideal	
Economic efficiency of company's activities (return)	Return on activities (ROA)	Effective	Tkachova (2012)
	Return on equity (ROE)	Non-effective	
	Return on sales (ROS)		
	Return on investments (ROI)		
Competitiveness (Ratio of competitiveness)	Indicators of financial development	High-competitive	Litovchenko and Golovko (2012)
		Same level of quality/costs ratio	
		Low level of competitiveness	
Aggregated approach	Return	Effective/ non-effective	Litovchenko and Golovko (2012)
	Liquidity	Absolute liquid/ liquid/ non-liquid balance model	
	Activity	Sufficient / non-sufficient duration of Production and Financial Cycles	
	Stability	Absolute financial stability/ Normal / Non-absolute financial stability/ Crisis	
Business process	KPI	High intensity	Litovchenko and Golovko (2012)
		Medium intensity	
		Low intensity	
Strategic system (strategic system leverage)	Marketing leverage	Effective/ non-effective company's strategic management	Litovchenko and Golovko (2012)
	Operating leverage		
	Innovative Management Ratio		
	Finance leverage		

Source: authors development by Gritsenko (2009), Guseva (2009), Tkachova (2012), Litovchenko and Golovko, 2012

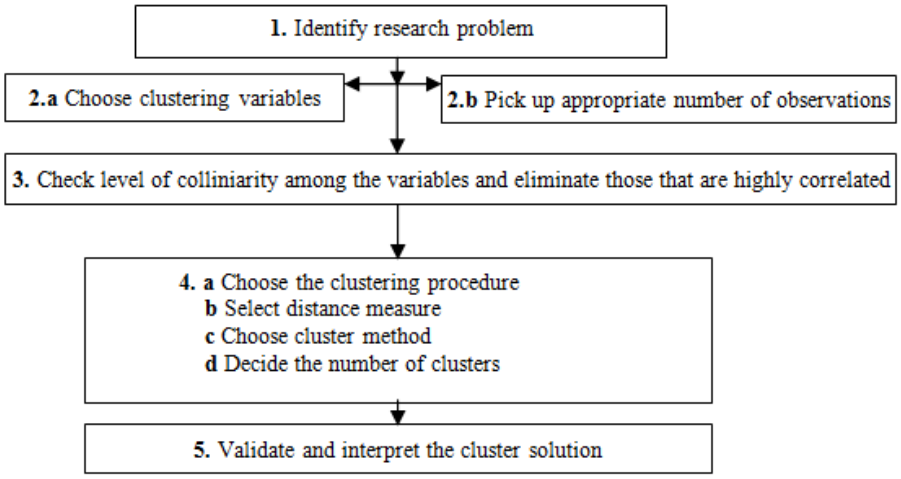
3. CONDUCTED RESEARCH

3.1. Data and methodology

Generally for the purpose of identifying groups of similar objects, scientists use cluster analysis procedure. As Mooi and Sarstedt (2011) defined cluster analysis is a convenient method for identifying homogenous groups of objects called clusters. Model of estimating connections and cluster grouping consists of several steps (Brauksa, 2013; Mooi and Sarstedt, 2011; Dibb, 1999; Kim *et al.*, 1989; Kotler and Keller, 2009; Tonks, 2009) that are presented at Figure 1.

According to Wedel and Kamakura (2000), there are several types of clustering variables and they can be classified into general (independent of products, services or circumstances) and specific (related to both the customer and the product, service and/or particular circumstance), on the one hand, and observable (i.e., measured directly) and

unobservable (i.e., inferred) on the other. In this scientific research general and observable clustering variables had been chosen.



Source: Mooi and Sarstedt (2011)

Figure no. 1 – Cluster analysis procedure

As a rule is that the "independent" clustering variables are associated with one or more "dependent" variables not included in the analysis. Given this relationship, there should be significant differences between the "dependent" variable(s) across the clusters. These associations may or may not be causal, but it is essential that the clustering variables distinguish the "dependent" variable(s) significantly (Mooi and Sarstedt, 2011).

The research with the respect of suggested cluster procedure (Figure 1) obtained the following results. The problem was to identify groups of enterprises with similar level of logistic system development and external flow indicators. Due to this in the following survey the key dependent variables were defined as duration of financial cycle of a company (FC), return on sales (ROS), duration of company's operating cycle (OC), and independent variable is return on logistic costs of enterprise as an indicator of company's logistic system efficiency (ROLI).

Number of observations is usually estimated as 2^m, where m – is the total amount of variables. So, in the present case the total amount of observations has to be no less than 16. The study investigates the performance of 6 industrial Ukrainian enterprises for 2.5 years (totally 60 observations). Each observation consists of 3 months period data gained from official and managerial inside sources, from the 3d quarter of 2012 to the 4th quarter of 2014. All studied enterprises form the potential of second sector of Ukrainian economy. The input data is presented in Table 2.

Table no. 2 – Research input data

Enterprise	Code of data	Variables	
		Code in SPSS	Indicator
FED Corporation LTD	F3-2012; F4-2012; F1-2013; F2-2013; F3-2013; F4-2013; F1-2014; F2-2014; F3-2014; F4-2014	VAR 00002	Return on Logistic Costs (ROLI) – **dependent** variable
Lozovaya Plant Traktorodetal	L3-2012; L4-2012; L1-2013; L2-2013; L3-2013; L4-2013; L1-2014; L2-2014; L3-2014; L4-2014	VAR 00003	duration of financial cycle of a company(FC) – **independent** variable
Kharkiv Plant of Electric Equipment	Z3-2012; Z4-2012; Z1-2013; Z2-2013; Z3-2013; Z4-2013; Z1-2014; Z2-2014; Z3-2014; Z4-2014	VAR 00004	return on sales (ROS) - **independent** variable
Plant Electrotyajmash	E3-2012; E4-2012; E1-2013; E2-2013; E3-2013; E4-2013; E1-2014; E2-2014; E3-2014; E4-2014	VAR 00005	duration of company's operating cycle (OC) - **independent** variable
State Scientific and Producing Union Communar	K3-2012; K4-2012; K1-2013; K2-2013; K3-2013; K4-2013; K1-2014; K2-2014; K3-2014; K4-2014		
State Plant Turboatom	T3-2012; T4-2012; T1-2013; T2-2013; T3-2013; T4-2013; T1-2014; T2-2014; T3-2014; T4-2014		
Total	6 enterprises; 60 cases	4 variables	

3.2. Empirical results

For the research the software SPSS was used. After data standardizing procedure the descriptive statistics analysis had been run. The results are presented in Table 3.

Table no. 3 - Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
VAR00002	60	1.00	32.00	16.2500	8.83488	78.055
VAR00003	60	-2633.00	3718.00	-26.6833	1244.38513	1548494.356
VAR00004	60	2.00	32.00	17.3333	10.38034	107.751
VAR00005	60	48.00	2043.00	343.7333	479.61743	230032.877
Valid N (list wise)	60					

Next step is to check the variables for collinearity. For this purpose the correlation analysis had been conducted. The results (Table 4) show the high level of dependence between ROS and FC.

According to the gained data ROS had been eliminated from the developing model. It can be explained as dependence between the level of company's sales and financial terms of cooperation with its suppliers and sales department. It shows us that H4 might be partly confirmed now and the marketing indicator impact on dependent variable ROLI will not be scrutinized. For the further calculations we estimate the dependent variable – ROLI, and independent variables are duration of financial cycle (FC) and duration of production cycle of enterprise (PC). Listed variables can be used now to characterize specific segment – profiling.

Table no. 4 – Correlations

		VAR00002	VAR00003	VAR00004	VAR00005
VAR00002	Pearson Correlation	1	-.211	.476**	-.083
	Sig. (1-tailed)		.053	.000	.265
	N	60	60	60	60
VAR00003	Pearson Correlation	-.211	1	-.244*	-.369**
	Sig. (1-tailed)	.053		.030	.002
	N	60	60	60	60
VAR00004	Pearson Correlation	.476**	-.244*	1	.156
	Sig. (1-tailed)	.000	.030		.116
	N	60	60	60	60
VAR00005	Pearson Correlation	-.083	-.369**	.156	1
	Sig. (1-tailed)	.265	.002	.116	
	N	60	60	60	60

**. Correlation is significant at the 0.01 level (1-tailed).
*. Correlation is significant at the 0.05 level (1-tailed).

For the next step of cluster procedure we had chosen hierarchical method of agglomerate clustering using Euclidian distance measure and Ward's method for the checking procedure. The number of grouped clusters is equal 4 and the results of observations are shown on dendrogram (Figure 2).

After gaining results the next step is to consult the agglomeration schedule (Annex A) to validate the presented number of clusters. Generally to make a decision on final cluster numbers the following rule have to be followed. The appropriate number of clusters is estimated as a deviation between number of cases iteration (59) and the numerical number of case when coefficient in agglomeration schedule changes its meaning dramatically (55). So, in our case the best quantity of clusters are 4. After it we ran ANOVA - one – step statistics to prove the validity of obtained results (Table 5).

On the next step we continue scrutinizing procedure of the number of clusters. We consult cluster membership (Annex B) to interpret the other possible amount of clusters.

Table no. 5 – ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
VAR00003	Between Groups	54412892.150	9	6045876.906	8.182	.000
	Within Groups	36948274.833	50	738965.497		
	Total	91361166.983	59			
VAR00005	Between Groups	6397601.800	9	710844.644	4.954	.000
	Within Groups	7174337.933	50	143486.759		
	Total	13571939.733	59			

To confirm gained results we will calculate clusters centroids by Wards method to evaluate the quality of got information (Tables 6, 7, 8).

Table no. 6 – Initial Cluster Centres

	Cluster			
	1	2	3	4
VAR00002	23.00	24.00	2.00	18.00
VAR00003	9.00	28.00	21.00	2.00
VAR00005	300.00	539.00	2043.00	48.00

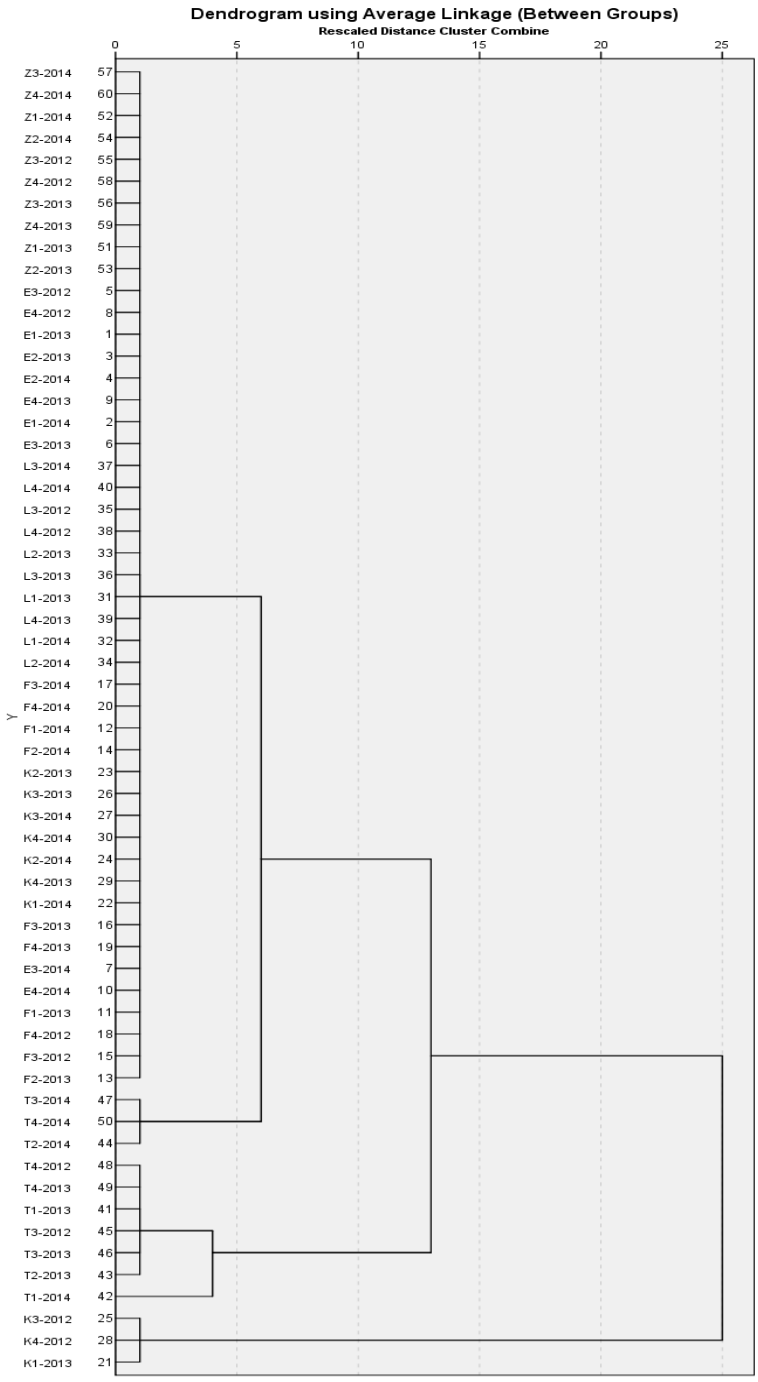


Figure no. 2 – Dendrogram of clusters

Table no. 7 – Iteration History

Iteration	Change in Cluster Centres			
	1	2	3	4
1	28.649	.000	11.543	52.006
2	8.114	.000	.000	6.381
3	9.064	.000	.000	6.145
4	.000	.000	.000	.000

Table no. 8 - Final Cluster Centres

	Cluster			
	1	2	3	4
VAR00002	13.71	24.00	13.00	16.93
VAR00003	8.67	28.00	24.50	20.41
VAR00005	290.24	539.00	2043.00	107.69

After it we initiate final two-steps cluster procedure to estimate the models quality.

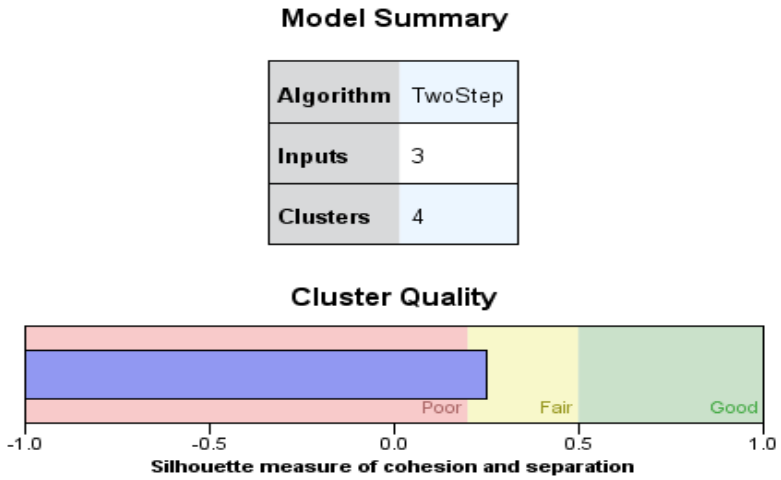


Figure no. 3 – Suggested 4-cluster model quality

Choice for the best clustering solution must be (Dibb, 1999; Tonks, 2009; Kotler and Keller, 2009) made under the following cluster's criteria: substantial, accessible, differentiable, actionable, stable, parsimonious, familiar, relevant, compactness and accountable. The increasing of Silhouette measure proves the appropriate classification gained by hierarchical method (Figure 3).

First of all, the developed model and number of clusters show a high degree of within-segment homogeneity and between-segment heterogeneity. Due to H2, it had been confirmed, though there are several types of industrial company's behaviour on the market and it can be measured and predicted by cluster analysis. So we may state according to developed model there are 4 clusters in the represented 60 cases of observation. It means that H4 was partly confirmed by obtaining the predicted groups.

Based upon conducted research the generalized results can be presented in Matrix (Figure 4). The general parameters for the developed model are level of ROLI and duration of Financial and Operation Cycles.

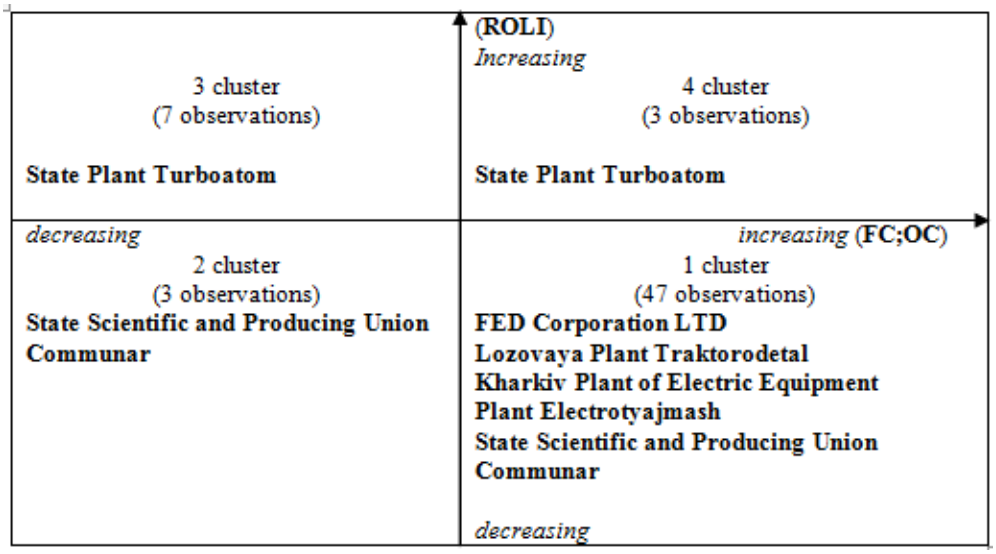


Figure no. 4 – Ukrainian industrial companies logistic system resulted clusters diagnostics Matrix

To sum up, the gained clusters can provide information about the company's market position. The worst cluster from the point of logistic system development and organizing terms and payments with contractors is cluster #1. Enterprises from this cluster can evaluate to cluster #2, which can state the better market position in order to optimize the duration of financial cycle and reconsider the terms of payment. The best strategic position on market is for enterprises of cluster #3, when the company develops steadily and invests in logistics improvement, and at the same moment optimizes its financial and material flow by using sufficient volume of own and borrowed money (sources) for producing renovation. Cluster #4 can be described as interspaced position, there is a situation when you still profit your investments but had stagnated relations with your consumers. So there are two solutions here: to develop into cluster #3 or have degradation into cluster #1.

4. CONCLUSIONS

Due to conducted research hypothesis H1 and H2 had been confirmed totally, H3 and H4 had been confirmed partly due to collinearity between ROLI and ROS. Managerial results of this survey are the gained data about number and key-point characteristics of different segments of Ukrainian industrial enterprises.

Key recommendations for the formed clusters are the following. First cluster has the most observations – 47 cases from total, the industrial companies that have no optimum structure of their financial payments, low estimated ROLI and long duration of operating cycle had been formed the core of this cluster. It proves H1 that stated that enterprises with the common duration of operating cycle (OC) and level of logistics return (ROLI)

implement the same strategy on the market, act the same way. Second cluster has different parameters meaning. The only enterprise of the second cluster is State Scientific and Producing Union Communar for three quarters (9 months period) when it was a stable development of a company and long term contracts under the conditions of prepayment were sighed up with international partners. It proves H3, which stated diminishing of Duration of Financial cycle (FC) and increasing Return on Logistic Costs (ROLI) can improve industrial company's market position. After scrutinizing additional managerial information of the company's performance, we may stress the general grows of key-indicators and can define its market position as stable development. The time when it happens to the studied enterprise it had been clustered at a separated group. Third cluster consists of 7 observations of State Plant Turboatom from the beginning of 3d quarter of 2012 up to the 1st quarter of 2014. This period can be defined as the most profitable one. The company had some long-term arrangements for turbines production. The fourth cluster can be described by 3 observations of State Plant Turboatom, the latest 3 periods (9 month of 2014). At the same moment, these observations can be described as no investments in development and no extra profit, just implementing planned indicators. Analysing the data of this cluster and changes of company's general tactics, grouping these observations was caused by loose of some international contracts and having the "waiting" position now on the market. This enterprise has no competitors on the world market, so now it is only the question of time for new contracts to sign, and the present cluster can be defined as interspaces position.

Future research development direction is to create and assume the theoretically based model of adaptive management of industrial enterprises logistic system that includes diagnostics of its internal and external flows and recommendations to improve its market position according to its life cycle.

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Annexes

Annex A – Agglomeration schedule

Stage	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	57	60	.000	0	0	4
2	56	59	.000	0	0	35
3	55	58	.000	0	0	38
4	52	57	.000	0	1	5
5	52	54	.000	4	0	43
6	51	53	.000	0	0	35
7	47	50	.000	0	0	10
8	48	49	.000	0	0	9
9	41	48	.000	0	8	12
10	44	47	.000	0	7	57
11	45	46	.000	0	0	12
12	41	45	.000	9	11	13
13	41	43	.000	12	0	56
14	37	40	.000	0	0	51
15	35	38	.000	0	0	49
16	33	36	.000	0	0	17
17	31	33	.000	0	16	37
18	27	30	.000	0	0	32
19	24	29	.000	0	0	23
20	25	28	.000	0	0	22
21	23	26	.000	0	0	34
22	21	25	.000	0	20	59
23	22	24	.000	0	19	32
24	17	20	.000	0	0	45
25	12	14	.000	0	0	45
26	7	10	.000	0	0	48
27	4	9	.000	0	0	30
28	5	8	.000	0	0	29
29	1	5	.000	0	28	31
30	2	4	.000	0	27	36
31	1	3	.000	29	0	41
32	22	27	25.000	23	18	34
33	11	18	25.000	0	0	40
34	22	23	51.000	32	21	47
35	51	56	100.000	6	2	38

Stage	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
36	2	6	225.000	30	0	41
37	31	39	256.000	17	0	44
38	51	55	275.000	35	3	43
39	32	34	324.000	0	0	44
40	11	15	453.500	33	0	46
41	1	2	568.750	31	36	53
42	16	19	576.000	0	0	47
43	51	52	1016.667	38	5	53
44	31	32	1099.000	37	39	49
45	12	17	1225.000	25	24	52
46	11	13	1483.667	40	0	48
47	16	22	2286.714	42	34	50
48	7	11	3453.750	26	46	50
49	31	35	4974.333	44	15	51
50	7	16	9636.500	48	47	52
51	31	37	9895.250	49	14	54
52	7	12	13476.967	50	45	55
53	1	51	14700.125	41	43	54
54	1	31	20446.033	53	51	55
55	1	7	53312.994	54	52	57
56	41	42	2262016.000	13	0	58
57	1	44	3608888.149	55	10	58
58	1	41	8240165.877	57	56	59
59	1	21	16693680.614	58	22	0

Annex B – Cluster membership

Case	4 Clusters	3 Clusters	2 Clusters
1:E1-2013	1	1	1
2:E1-2014	1	1	1
3:E2-2013	1	1	1
4:E2-2014	1	1	1
5:E3-2012	1	1	1
6:E3-2013	1	1	1
7:E3-2014	1	1	1
8:E4-2012	1	1	1
9:E4-2013	1	1	1
10:E4-2014	1	1	1
11:F1-2013	1	1	1
12:F1-2014	1	1	1
13:F2-2013	1	1	1
14:F2-2014	1	1	1
15:F3-2012	1	1	1
16:F3-2013	1	1	1
17:F3-2014	1	1	1
18:F4-2012	1	1	1
19:F4-2013	1	1	1
20:F4-2014	1	1	1

Case	4 Clusters	3 Clusters	2 Clusters
21:K1-2013	2	2	2
22:K1-2014	1	1	1
23:K2-2013	1	1	1
24:K2-2014	1	1	1
25:K3-2012	2	2	2
26:K3-2013	1	1	1
27:K3-2014	1	1	1
28:K4-2012	2	2	2
29:K4-2013	1	1	1
30:K4-2014	1	1	1
31:L1-2013	1	1	1
32:L1-2014	1	1	1
33:L2-2013	1	1	1
34:L2-2014	1	1	1
35:L3-2012	1	1	1
36:L3-2013	1	1	1
37:L3-2014	1	1	1
38:L4-2012	1	1	1
39:L4-2013	1	1	1
40:L4-2014	1	1	1
41:T1-2013	3	3	1
42:T1-2014	3	3	1
43:T2-2013	3	3	1
44:T2-2014	4	1	1
45:T3-2012	3	3	1
46:T3-2013	3	3	1
47:T3-2014	4	1	1
48:T4-2012	3	3	1
49:T4-2013	3	3	1
50:T4-2014	4	1	1
51:Z1-2013	1	1	1
52:Z1-2014	1	1	1
53:Z2-2013	1	1	1
54:Z2-2014	1	1	1
55:Z3-2012	1	1	1
56:Z3-2013	1	1	1
57:Z3-2014	1	1	1
58:Z4-2012	1	1	1
59:Z4-2013	1	1	1
60:Z4-2014	1	1	1