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ALGORITHM OF STABILIZATION OF LIFE CYCLE OF THE CONSTRUCTION ENTERPRISES

In the article developed an algorithm for stabilization of the life cycle construction companies, which allows the company to identify and select the purposeful direction of its development and capacity. The main components of the stabilization algorithm element of the life cycle of enterprises is the target stage – this is the stage at which the company reaches the performance of activities of the life cycle of the construction company the best in comparison to the reporting indicators. Timely detection of the target in the life cycle allows the company to achieve the highest performance throughout the life cycle.
Key words: life cycle of the enterprise, the stage of the life cycle, performance, activities, algorithm, stabilization, target stage.

Problem statement. In the course of its life cycle each enterprise aspires to reach the highest integrated index that reflects its life cycle efficiency at all stages. Life cycle of each enterprise is subject to the general development law. One of the main principles of the development law as applied to the life cycle is a principle of stabilization, i.e. a striving to stabilize the most efficient stages of the life cycle. We consider that for the life cycle the stabilization principle is most important, however, due to a timely and correct stabilization of the most efficient stages, each enterprise can extend its life cycle and achieve the maximum performance indices along the lines of its activity. Therefore we consider that it is necessary to develop an algorithm of the construction enterprise life cycle stabilization.

Analysis of latest studies and publications. Wide variety of issues connected with management concepts and enterprise life cycle assessment is disclosed in the works of M. Porter, K. Simons, J. Moore, J. Cristens, H. Fox, J. Vassin, D. Lippith, V. Schmidt, I. Adizes, L. Greiner, D. Miller and P. Frizen, D. Kats and R. Kann, B. Milner, S. Koryagina, G. Shyrokova, G. Kozachenko, O. Shatska et. al.

Highlighting parts of the general problem that have not been solved earlier. Development of an algorithm to stabilize the enterprise life cycle was not covered in any scientific work.

Objective of the paper. The main objective of this paper is to develop an algorithm of stabilization of life cycle of construction enterprises.

Presentation of the basic material. Development of an algorithm of stabilization of life cycle of a construction enterprise includes execution of the following sequential stages:

1. Identification of life cycle stages of a construction enterprise. It is done on the basis of performance indices referring to the activities during the life cycle of an enterprise.

It is expedient to calculate the performance index illustrating the operational activity of the life cycle of an enterprise as a ratio of the profit (loss)

resulting from operational activity to the average value of assets; the calculation takes into account a change of two indices: profitability of sales and turnover of assets [1, p. 121; 2, p. 54]:

$$P_{онд} = П(З)_{онд} \div А = Д_{онд} \div А \times П(З)_{онд} \div Д_{онд}, \quad (1)$$

where $П(З)_{онд}$ – profit (loss) from the operational activity; А – average value of assets; $Д_{онд}$ – income from operational activity.

Profitability of investments in the enterprise life cycle should be determined as a ratio of the profit gained from investments to the average value of non-current assets; at further expanding it is determined as a product of the investment profitability and turnover of the investment. Profitability index related to the investment component of the life cycle shows how many monetary units of the profit falls on a unit invested in non-current assets [1, p. 121; 2, p. 54]:

$$P_{інд} = П(З)_{інд} \div Необ.А = П(З)_{інд} \div Д_{інд} \times Д_{інд} \div Необ.А, \quad (2)$$

where $П(З)_{інд}$ – profit (loss) from the investment direction of the activity; Необ.А – the average value of non-current assets; $Д_{інд}$ – income from the investment direction of the activity.

Profitability index illustrating the financial direction of activity of the enterprise life cycle is determined as the net worth profitability based on the profit gained as a result of the financial activity, turnover of the attracted capital and the financial leverage coefficient of the enterprise [1, p. 121; 2, p. 54]:

$$P_{фнд} = П(З)_{фнд} \div ВК = П(З)_{фнд} \div Д_{фнд} \times Д_{фнд}, \quad (3)$$

where $П(З)_{фнд}$ – profit (loss) from the financial direction of the activity; $Д_{фнд}$ – income from the financial direction of the activity; ЗК – average value of the attracted capital; and ВК – average value of the net worth.

Specifically these profitability indices referring to the directions of activity of the enterprise life cycle have been chosen because in each specific case a certain kind of profit gained by the enterprise at various stages of the life cycle is determined.

The analysis of peculiar features of each stage of enterprise life cycle [3, p. 3; 4, p. 200; 5, p. 27] made it possible for us to form a matrix which defines the enterprise life cycle stages by the increment of growth of the profitability indices that characterize activities of the enterprise (Table 1).

2. Determination of the target stage of the enterprise life cycle includes several sub-items.

The target stage of the construction enterprise life cycle is a stage when the construction enterprise reaches efficiency figures referring to the activity directions of the life cycle that are better as compared to the reported figures. For each of six life cycle stages that we have selected there exists its own target stage which each enterprise should reach in order to achieve higher profitability indices, stability an, as a result, extension and support of the construction enterprise life cycle:

1. Rapid growth stage ⇒ gradual growth.
2. Gradual growth stage ⇒ stability.
3. Stability stage ⇒ rapid or gradual growth.
4. Gradual decline stage ⇒ stability.
5. Rapid decline stage ⇒ gradual decline.
6. Crisis stage ⇒ rapid growth.

Table 1

Matrix determining the enterprise life cycle stages by the increment of growth of the profitability indices that characterize the directions of its activity

Increment of growth of the index that characterizes the activity direction	Rapid growth stage	Gradual growth stage	Stability stage	Gradual decline stage	Rapid decline stage	Crisis stage
Operational direction of the activity	↑	↑	↑	↓	↓	↓
Investment direction of the activity	↓	↑	↑	↑	↓	↓
Financial direction of the activity	↓	↓	↑	↑	↑	↓

2.1. Determination of the direction of a change of the key profitability index referring to the enterprise life cycle direction of the activity that enables to achieve the target stage.

The key profitability index referring to the activity direction at a certain stage of the enterprise life cycle will be that activity direction index (of operational, financial or investment activity) which increase will bring the enterprise to a stage where it can achieve higher profitability index (target stage). Determination of the key index of the activity direction should be made with the aid of Table 1 where each enterprise life cycle stage is characterized by a gradual change of one of the profitability indices referring to the activity direction.

2.2. Determination of the most significant internal factor that impacts the key profitability index referring to the activity direction of the stage of the enterprise life cycle:

2.2.1. Computation of the quantitative impact of internal factors upon the key profitability index of the enterprise life cycle stage referring to the activity direction is made using the chain rule substitution method.

The chain rule substitution method is applied when studying functional dependencies and is intended to determine individual impacts of each internal factor upon the final figure provided the values of other analyzed factors are fixed. The essence of the method used within a frame of a functional model lies in a sequential alternate substitution of the reporting values for the basic values of factors. In doing so, the quantitative parameters are to be substituted in the first turn [6, p. 83].

First of all it is required to construct a table listing on top all necessary internal factors. The number of substitutions is determined by a number of internal factors that impact the final profitability index referring to the activity directions plus one. In the second line of the table the reporting value is substituted for the basic values of the internal factors of the key profitability index referring to a certain activity direction (zero substitution). In the third line of the table (second substitution) the value of the reporting year is also substituted for the basic value of another internal factor of the key profitability index provided the first factor also remained the reported one. Corresponding substitutions are to be made until the reported figures are completely substituted for the internal impact factors (the last substitution).

Now we compute the products of the internal impact factors for each substitution. Having calculated the products, it is required to determine the im-

pact of each of the internal factors upon the key profitability index referring to a certain activity. The impact of the first internal factor is determined as a difference between the calculated factor of the products of the first substitution internal factors (P1) and the calculated factor of the zero substitution internal factors (Рб). The impact of the second internal factor is determined as a difference between the calculated factor of the products of the second substitution internal factors (P2) and the calculated factor of the products of the first substitution internal factors (P1). The third factor impact is determined as a difference between the calculated factor of the products of the third substitution internal factors (P3) and the calculated factor of the products of the second substitution internal factors (P2). The fourth factor impact is determined as a difference between the calculated factors (Рз) and (P3) (the proposed computation process is shown in Table 2.

Table 2

Computation of the impact factors by the chain rule substitution method

Substitution number and factor description	Factors impacting the index				Product of factors	Factor impact value
	1-й	2-й	3-й	4-й		
Zero substitution	Б	Б	Б	Б	Рб	-
First substitution (1st factor)	З.	Б	Б	Б	Р1	P_1-$P_п$
Second substitution (2nd factor)	З	З	Б	Б	Р2	P_2-P_1
Third substitution (3rd factor)	З	З	З	Б	Р3	P_3-P_2
Fourth substitution (4th factor)	З	З	З	З	Рз	$P_{зв}$-P_3

The legend: Б – basic values of indices of the internal factors; З – reported values of indices of the internal factors п; 1st, 2nd, 3rd and 4th – quantitative factors.

2.2.2. Selection of the internal factor that mostly impacts the key profitability index referring to the activity direction of the enterprise life cycle stage. The direction and the value of impact of each internal factor are determined by computing the quantitative impact of internal factors upon the key profitability index referring to the activity direction of the enterprise life cycle with the aid of the chain rule substitution method.

As far as stabilization is aimed at achieving the life cycle stage (target stage) where the profitability indices referring to the activity directions of the life cycle will acquire greater total profitability than at the previous life cycle stage, we are of opinion that the factor which mostly impacts the key profitability index at the decline stages will be that one which produces the most negative effect on the key profitability index referring to a certain activity direction because it is due to that factor that the enterprise rapidly reduces the profitability of the activity directions; and at the growth stages the most impacting factor will be that one which considerably increases the key profitability index of the activity directions of the enterprise life cycle as compared with the action of the other factors.

2.2.3. Computation of the value of the mostly impacting internal factor that enable to achieve the increment of the key profitability index referring

to the enterprise life cycle activity stage with the aid of the data analysis package «Finding Solutions» and «Parameter Selection» [7, p. 125; 8, p. 218].

3. Computation of the target integral index referring to the enterprise life cycle stage based upon the key value of the profitability index of the activity of the life cycle stage will be conducted in accordance with formulae 4-9 as a sum of products of the profitability indices referring to three activity directions multiplied by the corresponding weight indices of each stage of the construction enterprise life cycle:

$$I_{j(ш.р.)} = K_{1.1} \times P_{онд} + K_{1.2} \times P_{інд} + K_{1.3} \times P_{фнд} \quad , \qquad (4)$$

$$I_{j(п.р.)} = K_{2.1} \times P_{онд} + K_{2.2} \times P_{інд} + K_{2.3} \times P_{фнд} \quad , \qquad (5)$$

$$I_{j(ст.)} = K_{3.1} \times P_{онд} + K_{3.2} \times P_{інд} + K_{3.3} \times P_{фнд} \quad , \qquad (6)$$

$$I_{j(п.п.)} = K_{4.1} \times P_{онд} + K_{4.2} \times P_{інд} + K_{4.3} \times P_{фнд} \quad , \qquad (7)$$

$$I_{j(ш.п.)} = K_{5.1} \times P_{онд} + K_{5.2} \times P_{інд} + K_{5.3} \times P_{фнд} \quad , \qquad (8)$$

$$I_{j(кр.)} = K_{6.1} \times P_{онд} + K_{6.2} \times P_{інд} + K_{6.3} \times P_{фнд} \quad , \qquad (9)$$

where $К_{1.1\text{-}1.3}$, $К_{2.1\text{-}2.3}$, $К_{3.1\text{-}3.3}$, $К_{4.1\text{-}4.3}$, $К_{5.1\text{-}5.3}$, $К_{6.1\text{-}6.3}$ – weighing coefficients of the activity directions at each stage of the enterprise life cycle; $Р_{онд,інд,фнд}$ – profitability index of the operational, investment and financial activity directions of the enterprise life cycle.

The general weighing coefficients for each activity direction at each stage of the life cycle are calculated for five enterprises as the arithmetic means:

$$K_{ij} = \sum K_{ij} \div n \quad , \qquad (10)$$

where K_{ij} – weighing coefficient of each activity direction of the enterprise life cycle at a corresponding stage; i – one of three activity directions of the enterprise life cycle; j – corresponding stage of the enterprise life cycle; and n – number of years of stay in the j-th stage of the life cycle.

Special attention should be given to that life cycle stage of the construction enterprise wherein it stays just now because to preclude, in future, the advent of the decline stages and move to those enterprise life cycle stages where the profitability indices achieve the maximum values is possible only in case of timely identification of the biggest weight factors of the certain stage profitability indices.

So, by accomplishing this algorithm we established that in 2011 the construction enterprise «Sana, Ltd.», which activity we analyzed, was at the stage of rapid decline.

The stage of gradual decline is the target stage which an enterprise should aspire to achieve. As far as the enterprise staying in the rapid decline stage exhibits a reduction of the profitability indices from operational and investment activity directions, so in order to avoid the next stage (crisis stage) the enterprise should, despite internal factors of each activity directions, support and raise its efficiency that takes place at the gradual decline stage when a growth of the profitability indices from the investment activity direction is observed.

To achieve the target stage, it is necessary that the enterprise stabilize and improve the profitability indices of the investment direction of activity so as

to move from the rapid decline stage to the target stage of gradual decline.

In order to determine the most significant internal factor impacting the key profitability index referring to the activity direction of the construction enterprise life cycle stage, we, first of all, calculated the quantitative impact of internal factors upon the key profitability index of the construction enterprise life cycle stage using the method of chain rule substitution method (Table 3).

We note that each profitability index referring to a certain activity direction was expanded in accordance with the formulae 1-3, where Pi is the investment profitability and Об(i) – turnover of the investments.

An enterprise staying at the rapid decline stage is characterized by a reduction of the investment activity index by 6.31% which was influenced by 2 factors: the reduction of the investment profitability by 73.31% resulted in a reduction of the profitability index by 11.51% while an increase of the investment turnover by 11.59% facilitated a growth of the profitability index by 5.2%.

On the basis of the conducted calculations referring to the enterprise the quantitative impact of internal factors, the most weight factor of impact upon the profitability index of the investment activity direction at the rapid decline stage turned to be the investment turnover index which directly influences the profitability index and, if the investment profitability index grows, the profitability index of the investment activity also increases.

Table 3

Quantitative impact of internal factors upon the profitability index of the investment direction at the rapid decline stage

Substitution number and factor description	Factors impacting the index		Product of factors (%)	Factor impact value (%)
	Рін(од.)	Об(i) (од.)		
Zero substitution	0.8813	0.2657	23.42	-
First substitution (Рін)	0.4482	0.2657	11.91	-11.51
Second substitution (Об(i))	0.4482	0.3816	17.10	5.2

Thus, having identified the most weight internal factors of the key index of the enterprise at the target stage, it is then required to calculate the value of the most weight internal factor of impact that will make it possible to achieve the increment of the key profitability factor referring to the particular stage of the enterprise ;life cycle.

To this end, we use «Excel» program and the data analysis package «Finding Solutions» and «Parameter Selection» to find the values of the most weight internal impact factors upon the key profitability index to achieve the target stage.

A necessary condition for the profitability indices referring to the construction enterprise life cycle stages when they shift to the target stage is an increase of the value of the key profitability index for a particular activity direction at least by 1% as compared with the previous year.

Therefore, when we calculated the values of the most weight internal factors impacting the key profitability index, we used just this condition to achieve the target stage (Table 4).

For Enterprise 5 to increase the profitability index of the investment activity by 1% in order to achieve the target stage (gradual decline), it is required to increase the investment turnover index by 2.22%.

Table 4

Values of the investment turnover index required to achieve the target stage

Indices (unit) / Stages	Turnover of investments (unit)	Profitability of investments (unit)	Profitability of the investment activity (unit)
«Sana, Ltd.»			
Rapid decline	0.3816	0.4482	0.1710
Gradual decline	0.4038	0.4482	0.1810

Thus, having determined the values of the most weight factors impacting the profitability index of the investment activity of the life cycle of the enterprise desiring to achieve the target stage, it is possible to determine the integral index of the target stage and compare its value with the values of the integral indices of the 2011 stages.

Table 5

Value of the integral index of the target stage of the construction enterprise life cycle

Enterprise	Stage	Value of the integral index of a stage (unit)	Target stage	Value of the integral index of the target stage (unit)
1	Rapid decline	0.3946	Gradual decline	0.4095

It follows from Table 5 that upon reaching the target stage the enterprise can considerably increase the integral profitability index of the enterprise life cycle.

Conclusions and proposals. On the basis of the obtained data referring to the integrated index of the target stage of the construction enterprise life cycle it can be concluded that a timely identification of the key activity of the life cycle and determination of the most weight internal factor that impacts a change of the key profitability index at a certain life cycle stage, will assist an enterprise to achieve more stable and higher values of the profitability indices referring to the activity of the life cycle of an enterprise and its integral index of the enterprise life cycle stages.

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АЛГОРИТМ СТАБІЛІЗАЦІЇ ЖИТТЄВОГО ЦИКЛУ БУДІВЕЛЬНИХ ПІДПРИЄМСТВ

Резюме
У статті розроблено алгоритм стабілізації життєвого циклу підприємств будівельного комплексу, який дозволяє підприємству виявити і вибрати цілеспрямований напрямок його розвитку та нарощування. Головним складовим елементом алгоритму стабілізації життєвого циклу підприємств є цільова стадія – це стадія, на якій підприємство досягає кращих показників ефективності напрямів діяльності життєвого циклу будівельного підприємства в порівнянні з звітними показниками. Своєчасне виявлення цільової стадії життєвого циклу дозволяє підприємству досягати найбільших показників ефективності протягом усього життєвого циклу.
Ключові слова: життєвий цикл підприємства, стадія життєвого циклу, показники ефективності, напрямки діяльності, алгоритм, стабілізація, цільова стадія.

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АЛГОРИТМ СТАБИЛИЗАЦИИ ЖИЗНЕННОГО ЦИКЛА СТРОИТЕЛЬНЫХ ПРЕДПРИЯТИЙ

Резюме
В статье разработан алгоритм стабилизации жизненного цикла предприятий строительного комплекса, который позволяет предприятию выявить и выбрать целенаправленное направление его развития и наращивания. Главными составляющими элементом алгоритма стабилизации жизненного цикла предприятий является целевая стадия – это стадия, на которой предприятие достигает показателей эффективности направлений деятельности жизненного цикла строительного предприятия, лучшего по сравнению с отчетными показателями. Своевременное выявление целевой стадии жизненного цикла позволяет предприятию достигать наибольших показателей эффективности на протяжении всего жизненного цикла.
Ключевые слова: жизненный цикл предприятия, стадия жизненного цикла, показатели эффективности, направления деятельности, алгоритм, стабилизация, целевая стадия.