

# APPLIED IMPLEMENTATION OF COMMON ACTIVITIES RESULT REDISTRIBUTION IN SALES DEPARTMENT OF MODERN ORGANIZATION USING SHAPLEY VALUE CALCULATION

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**Abstract:** *this article answers the question of the fair distribution of the result of joint labor, based on existing economic works and game theory applications. Results of the work can be successfully applied to the modern sales department as part of the process of bonus redistribution between the department's employees according to their contribution to the overall result. Using the Shapley value instead of the existing distribution practices makes it possible to optimize and revitalize the existing practice of compensating employees of the sales departments in a modern organization, where the results of this work can be successfully applied.*

**Keywords:** *entrepreneurship, sales department, Shapley value, optimization, result redistribution, bonus, sales compensation, business analytics, business analysis.*

## ПРИКЛАДНОЕ ПРИМЕНЕНИЕ ЗАДАЧИ РАСПРЕДЕЛЕНИЯ РЕЗУЛЬТАТА СОВМЕСТНОЙ ДЕЯТЕЛЬНОСТИ В ДЕПАРТАМЕНТЕ ПРОДАЖ СОВРЕМЕННОЙ ОРГАНИЗАЦИИ ЧЕРЕЗ РАСЧЕТ ВЕКТОРА ШЕПЛИ Степанов П.Н. (Российская Федерация)

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**Аннотация:** *статья отвечает на вопрос справедливого распределения результата совместного труда, основываясь на существующих работах экономики и теории игр. Результаты работы могут быть с успехом применены для современного отдела продаж в рамках процесса распределения бонуса между сотрудниками департамента согласно их вкладу в общий результат. Использование вектора Шепли вместо существующих практик распределения позволяет оптимизировать и оздоровить существующую практику компенсации сотрудников отделов продаж современной организации, где и могут быть с успехом применены результаты данной работы.*

**Ключевые слова:** *предпринимательская активность, отдел продаж, вектор Шепли, оптимизация, распределение результата, бонус, компенсация отдела продаж, бизнес-аналитика, бизнес-анализ.*

The article presents the results of applied testing via Shapley Value calculation [1] for cooperative games within the framework of game theory for the practical task of dividing and distributing the result of joint activity in the sales departments of modern organizations. The most relevant particular case of this work for the modern sales department is the distribution of the bonuses distributed to the whole sales department. This division should be made between the employees of the department in accordance with their contribution to the overall result.

Main problems of distributional task are:

- missing the data to support calculations of split between total result owners;
- missing the concepts to support mechanics of distribution;
- wrong heuristics [2] provided by persons responsible for distribution.

Cooperative games [3] theory showed very optimistic results in cases of common activity and redistribution of this activity result between participants. Final result of redistribution can be made by Shapley Value calculation. It was named in honour of Lloyd Shapley, who showed calculation in 1953 [4]. For each cooperative game Shapley Value assigns a unique distribution among the participants (players) of a total result generated by the coalition of all players. Shapley Value basically was designed as a collection of desirable properties in the output with collection of partial results of separate participants' coalitions.

Cooperative behavior of economic subjects like sales representatives in the same organization has become particularly relevant in the context of introducing more complex systems of final result redistribution calculations and in context of improvement through information exchange. Redistributing of final result between employees, companies pursue the goals of achieving and enhancing sales power and efficiency, being beneficially cooperative. Depending on the degree of concentration of the sales representatives or other employees in sales organization for operating interacting roles, the formation of coalitions between them can lead strengthening of result influence through the enlargement of their impact. It also helps improving the quality

of work through sharing results of their products and services, for example, through making impacting each additional player to each coalition for strength. Moreover, it's believed that often the team play represents the amount of the fair value of the final business result redistribution and the projected synergy, which makes such a transaction more profitable for each participant being added to the team than being an individual contributor. Of course, such integration behavior increases the sales power of sales units like coalition of separate player, and therefore affects their value. Especially it's profitable and important for players who're not calculated by sales result like sales excellence, licensing groups, business groups without revenue/sales quotas. In the next part of this article I show how to calculate such cooperation effect and impact through Shapley Value calculation.

When we face with cooperative game, let's arrange players arbitrarily. We can add them one by one and each next gets the winnings that he brought. Such a sharing, in general, depends on the order, so Shapley suggested averaging over the set of all possible orders of players ( $S_n$  – set of permutations of players,  $v_\sigma$  – division of players under the permutation  $\sigma$ ):

$$Sh = \frac{1}{n!} \left\langle \sum_{\sigma \in S_n} v_\sigma \right\rangle$$

For example, in games with three players, it is necessary to average six different sharing values with the final result of  $\{ V_1/3!; V_2/3!; V_3/3! \}$ :

Table 1. Shapley calculation for three players

Coalition / Player	A	B	C
ABC	$V_{11}$	$V_{12}$	$V_{13}$
ACB	$V_{21}$	$V_{22}$	$V_{23}$
BAC	$V_{31}$	$V_{32}$	$V_{33}$
BCA	$V_{41}$	$V_{42}$	$V_{43}$
CAB	$V_{51}$	$V_{52}$	$V_{53}$
CBA	$V_{61}$	$V_{62}$	$V_{63}$
SUM	$V_{1\text{ avg}}$	$V_{2\text{ avg}}$	$V_{3\text{ avg}}$

Using such method of calculation we need to set a rules for sales department to make applicable Shapley Value for joint result distribution. Each player A/B/C will be a different player in team when we speak about sales department:

- $A_1, A_2, A_3$ , etc. – account managers for each deal;
- $P_1, P_2, P_3$ , etc. – partner account managers connected to each deal;
- $S_1, S_2, S_3$ , etc. – sales leads or any other decision makers connected to work with customer;
- $B_1, B_2, B_3$ , etc. – business group product experts connected to each deal;
- $L_1, L_2, L_3$ , etc. – licensing group experts connected to each deal;
- $T_1, T_2, T_3$ , etc. – technical experts connected to each deal.

Finally for each deal we'll have a result of cooperative game like this:

- Deal 1:  $A_1, P_2, L_1, T_2$  – coalition of participants with final result  $N_1$  \$;
- Deal 2:  $A_2, P_2, L_4, S_2, B_1$  – coalition of participants with final result  $N_2$  \$;

This redistribution should be added to the final calculation according Shapley Value calculation rules. This result has the same limitation principles of Shapley Value calculation like disputes about distribution when core is not blank and Shapley Value is outside the core. But we can model class of the game to avoid such disputes and such type of distribution.

Also one more problem should be considered to make result of redistribution more "honest". The question of the duplication of records in client bases and the distribution of the result of joint activity to individual duplicate entities assigned to individual consumers of the result, within the framework of calculating the final total, expressed in profit, income, fulfillment of the plan, bonus, etc., is sometimes a critical problem for sales departments of a modern organization. For example, the growth of planned indicators from period to comparative period, can be up to 30%. While the incorrect offset of results, as a consequence of the non-optimal nature of deduplication algorithms in client databases or as a consequence of arbitrary transfer of the result of joint activity from owner to owner without observing strict principles of distribution of result, leads to an error of up to 20%, which can constitute a significant part or even completely cut off potential efforts to achieve planned growth rates. Therefore, close attention to the issue of regulating the segmentation of duplicate records between record owners is important.

Let's consider the typical scenarios of the expected deviations from the optimal offset of the result of joint activity in one of the next articles. Just need to emphasize that as a result of the final classification of scenarios for attributing the result of joint activities, the logic and principles of distribution of the results of joint activities become understandable. Each of the rules individually improves the recognition of the result to 5-10%, and collected together into a single system, they allow achieving an improvement in recognition of the result to 20%.

An organic addition to this scenario approach is a set of principles by which the organization recognizes duplication. List of parameters for which there is a paired comparison of potential customer-duplicates and scoring of this kind of comparison of indicators. All this, as well as tools for algorithmically identifying and distributing duplicate entities within a single database, constitute a solid base for the organization, which includes the structure of the sales department and an analytical structure that allows to simplify and reduce the work of the sales department, not related to the target indicators of employees.

Being returned back to the main topic of this article, we can conclude the following. Using the Shapley value instead of existing distribution practices allows in some cases to increase the amount of compensation for the most productive employees to a three-digit percentage increase in compensation and give them additional motivation in the form of positive reinforcement to continue the delivery of the result in the future. Symmetrically, the described scheme allows to reduce compensation payments by 50% or more to the participants, least involved in the final result, thereby eliminating the system with negative feedback. Together, the two main results of the work allow us to optimize and improve the existing practice of compensating employees of the sales departments of a modern organization, where the results of this work can be successfully applied in addition to other concepts of Shapley Value applications. Hart (1989) provides list of such applications [5]. Application, which we consider in this article, can be reiterated by business analysts and sales excellence managers of modern sales organization together with other tools like toolbox for small and midsize organizations [6] and other types of sales modeling for increasing sales department KPIs [7].

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