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Internal Communication in R&D: Decision-Making Methods Based on Expert Approaches

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Abstract: Relatively recently, internal communication received little attention from theorists, since they focused on external communication. The importance of internal communication is seen as the taker of responsibility for all internal exchanges of information between internal stakeholders at all levels. However, interdisciplinary cooperation in terms of internal communication is a significant issue for any organization running the R&D process. Different studies have already revealed strong links between communication and R&D success, but a lack of research continuity is visible, especially one relevant in practice. This article examines communication in the R&D process through the prism of decision making. It aims to take experience from R&D experts to supplement a list of decision-making methods used in the R&D process, which is compiled based on literature analysis. In the next stage of the investigation, the list of decision-making methods is used to determine the weights of the methods, which reflect the suitability of the decision-making methods in the R&D process. In the final stage of the investigation, differences in the evaluations of the US and German experts are presented, reflecting different experiences and differences in the conditions of the business environment.

Keywords: internal communication in R&D; decision-making methods in R&D process; multi-criteria decision making (MCDM) methods

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1. Introduction

Internal communication has become more complex and challenging in today's turbulent business environment. According to Yeomans and FitzPatrick (2017) [1], until relatively recently, internal communication received little attention from public relations theorists, since their focus was on external communication. Understanding the importance of internal communication in business can guarantee the ability to make decisions objectively and prevent unproductive investments. The importance of internal communication is based on different sides. It is seen as the taker of responsibility for all internal exchanges of information between stakeholders at all levels [2], as an integral part of employee participation [3,4], as a guarantee of transparency when merging all internal stakeholders [2], and as a strategic tool for success [5]. Therefore, it is evident that a lack of internal communication can cause unwanted effects on an organization [6], or the top management team (TMT) will not be able to make appropriate and valid decisions, which can negatively affect the use of innovations [7,8].

Different studies have already revealed strong links between communication and R&D for decades [9,10]. Heinzen et al. (2018) [11] named communication as the main success factor for R&D activities, Arai (2002) [12] dedicated the research to the particular mode of business communication in R&D activities. Chirumalla et al. (2018) [13], Becker and Lillemark (2006) [14], and Fain et al. (2011) [15] analyzed the marketing and R&D interface. Alderman et al. (2022) [16] stressed the importance of communication, general knowledge, and decision making in the capacity to innovate. However, the role of internal communication in R&D activities over the last decade has been vaguely analyzed. Several authors should be mentioned concerning internal communication research in the R&D process. Allen et al. (1980) [17] highlighted that there is a positive relation between internal communication and R&D. Song et al. (2010) [7] stressed interdisciplinary communication as a top issue for any organization running the R&D process. Jacobsen et al. (2014) [18] emphasized the need to improve internal communication between different functions of the R&D process. R&D stages aim to achieve the final goal by running different processes almost in parallel and different applications of new knowledge and creating tangible and intangible assets. There are many different R&D functions and requirements throughout the entire R&D process. Without forgetting the importance of the employees and process participants responsible for different activities, internal communication is vital for any company running the R&D process.

Based on the reasons listed above, the purpose of this work was defined: combining the literature analysis and the experience of R&D experts to prepare a list of decision-making methods used in the R&D process and to evaluate the appropriateness of these methods using the weighting technique based on multi-criteria decision making (MCDM) methods. To rank the research results, we arrange them according to weight and determine the differences in evaluation between the US and German experts.

The paper is organized as follows. First, the theoretical aspects of the role and importance of internal communication in R&D are provided. Subsequently, communication in the R&D process is examined through the prism of decision making and aims to compile a list of methods used in the R&D decision-making process. Based on the literature, we select five methods in research, leaving the possibility for experts to state additional methods, and a list of decision-making methods intended for significance evaluation is prepared. In the second research stage, the evaluation results of the US and German experts are presented, and the differences in these results are provided. The research was carried out based on experts working in the field of R&D in Germany and the USA.

2. Theoretical Aspects of Internal Communication and Methods for Decision Making in the R&D Process

The importance of internal communication in the company's internal processes, as well as the importance of interdisciplinarity and ensuring compatibility between different company departments, has not been examined much. Castanias and Helfat (2001) [19] emphasized the importance of top management communicating more closely with employees as the main link between the internal and external needs of the company. O'Reilly and Tushman (2004) [20] examined the emerging difficulties and the importance of communication in coordinating the distribution of responsibilities between departments in creating new innovations and suggested creating independent units as an alternative in case of miscommunication between old and new units. Song et al. (2010) [7] found a positive relationship in internal communication between the chief information officer (CIO) and TMT to promote innovations, in parallel covering internal communication between top managers and line managers. Song et al. (2010) [7] stressed the TMT gap to understand better the benefits, development trends, new ideas, and methods. Therefore, interdisciplinary cooperation in internal communication is a significant issue for any organization running the R&D process. Kanchanabha and Badir (2021) [21] support knowledge sharing at the team level as a prerequisite for transparent internal communication that ensures the understanding and growth of team members.

Many companies realized the importance of communication (mostly external). However, the contribution of internal communication as a precondition to the successful functioning of the company during the R&D process has not been given a full role.

One of the most important and maybe even critical aspects of internal communication is the decision-making process. Matheson et al. (1994) [22] emphasized the importance of the quality of R&D decisions from research to the integration of new technology. Alderman et al. (2022) [16] highlighted the importance of hiring top positions concerning the decision-making capabilities that the CEO should cover. Zhou et al. (2022) [23] mentioned trust and information sharing within the TMT as the main conditions to ensure each member's strengths in decision making. Schmidt et al. (2001) [24] researched the effectiveness of decisions made in the new product development (NPD) process while evaluating different methods for the decision-making process. They evaluated the differences between individuals acting alone and working in teams, highlighting the effectiveness and expecting that decision-making teams would be more effective than individuals [24], with less risk of errors and more representative decisions for all team members [25]. Additionally, they highlighted wider access to information than an individual player [25,26]. Despite higher support for the team approach, several highlights for individuals are worth noting. The team would rarely exceed the level of the best team member, proceed with the information effectively due to its overload [27], and find it more challenging to reach a unanimous agreement and make a joint decision that suits everyone [25].

If we go back to the team approaches, teams could be distinguished depending on the place of execution, face-to-face team, and virtual team. Cooper (2001) [28] and Patti et al. (1997) [29] support the face-to-face team approach. This team reports a higher level of satisfaction [30], while Fjermestad and Hiltz (1998) [31] suggested that the virtual approach has a potential effect on teamwork. In addition, team approaches could differ according to the voting system. When all team members vote as equal members, we can call it a simple vote system. Another method based on voting is the Scorecard-based method of voting for different evaluation criteria. This method was created decades ago and is used in the stage-gate process. Many companies have modified and improved the stage-gate product development model proposed by Cooper (2009) [32]. In this model, the development of a new product is divided into stages (stages), which are connected by decision making and control points (gates). The project evaluation tool Scorecard is intended for gates 1, 2, and 3, during which, based on the evaluation results, it is decided whether to continue the product development or stop it. In these control stages, the projects are rated by the top executives, taking into account the value of six factors grouped on a scale of 0–10. The evaluation of the project's attractiveness is weighted when evaluated by voting for different criteria that have a predetermined significance or are unweighted, taking into account the averages of the assessment of all evaluators. A score of 60/100 usually means a favourable decision [32].

Another distinguished approach was related to a different time or place or dispersed teams [33]. As in all methods, several critical points can also be mentioned in this one. Effective communication between team members and trust are critical success factors in overcoming distance complications [34]. Kossler and Prestridge (2004) [35] identified time, distance, and culture as possible obstacles to making a successful final decision without delay. In defiance of some sensitive nuance of the usage of the method, Ocker et al. (1995) [36] highlighted this approach as a higher quality decision than face-to-face teams. Dispersed teams conduct more in-depth research and compare and generate more diverse perspectives. Jarvenpaa and Leidner (1999) [37] analyzed the "swift" trust that ignores interdisciplinary research and does not specify trust building, which dispersed teams could experience. Kossler and Prestridge (2004) [35] identified cultural diversity, international markets, and cost-effectiveness as the main reasons for dispersed team building.

One of the most cited methods for innovations and new product development stages is the design-thinking technique. A significant part of the process-solving activities in design thinking involves the ability to synthesize knowledge from a variety of sources. Design thinking is also an approach that can be used to consider issues and resolve problems more broadly than within professional design practice and has been applied in business and to social issues. This process commonly uses five steps: empathize, define, ideate, prototype, and test. However, in the literature, a seven-step process can also be found [38]. It is a technique used in business that combines designer sensibility and methods to meet the needs of the customer with what is technologically feasible and what a viable business strategy can convert into customer value and market opportunity [39]. It strengthens organizational innovation capability [40] and offers an original approach to problem solving during an R&D process [41]. Micheli et al. (2019) [42] systemized the eight most used design thinking methods and tools: ethnographic methods, personas, journey maps, brainstorming, mind maps, visualization, prototyping, and experiments. However, the great importance of this method is reflected in the improvement in communication between designers and managers [43,44]. It is seen as a technique that fosters innovation [45]. Some authors recognized the implementation and usage of this method as a bunch of inexactitudes [46,47]. Micheli et al. (2019) [42] acknowledged the existing ambiguities between the attributes of the method and especially its applicability when Wrigley et al. (2020) [48] declared the existence of little knowledge of a successful design-thinking implementation process throughout an organization. Carlgren and BenMahmoud-Jouini (2021) [49] stressed the potential cultural conflicts between the company's values and the new method the company intends to implement. This reason could be a pretext for this method's still timid and sluggish use.

To summarize, all the above methods could be classified into five groups:

1. The decisions made unilaterally by one of the managers;
2. The decision is made based on the majority votes. In this case, teams take face-to-face or virtual meetings under an umbrella and use a simple voting system;
3. The Scorecard-based method, where in order to make the decision, voting is carried out for different evaluation criteria that have or do not have a predetermined weight;
4. The dispersed team-making technique approach was related to different time or place teams. Dispersed teams ignore the meeting's physical conditions, conduct more in-depth research and comparisons, and generate more diverse perspectives. While using this technique, the decisions are made based on the results of market research or patent searching;
5. The design-thinking technique combines the designer's sensibility and methods to meet customer needs with technological capabilities and what a viable business strategy can convert into customer value and market opportunity [35].

The set of R&D decision-making methods presented above was used in the following study sage to determine the opinions of the two groups of experts on the suitability of the methods.

3. Materials and Methods: Development of a List of Decision-Making Methods in the R&D Process and the Determination of Significance

A research questionnaire was created based on the list of decision-making methods prepared by the scientific literature. The first experts were asked to mark or name methods used or known for decision making in the R&D process. At the end of the list of methods presented in the table, the experts had the opportunity to enter or name and describe a method not mentioned on the list. In this way, the aim was to select sufficiently competent experts who have used in past or are familiar with the methods in the list and to supplement the list of methods prepared based on literature analysis for the next round of interviews. The initial goal was to conduct interviews with 30 experts from the US and 30 experts from Germany. However, to obtain an equivalent number of responses, and to use only qualitatively completed tables for the research, 25 responses from US experts and 25 from German experts were selected for analyzing the results.

For the second round, a table was prepared with the listed decision-making methods based on the results of the first stage, and competent experts were selected. In this round aimed at measuring the weights of the methods in the R&D process (i.e., to determine the opinions of selected, competent experts on the suitability of the decision-making methods for the R&D process). Experts were asked to break down 100 percent for each listed decision-making method. Taking into account the quality of the completed questionnaires and the equivalent number of responses, 18 US and 18 German R&D experts completed the answer tables. The research was conducted in the US from December 2021 to January 2022 in San Francisco, Los Angeles and Germany at the end of May and the beginning of June 2022 in Hanover during the Hanover Messe 2022 technology fair. The research was focused on organizations that create technologies and, based on them, develop, manufacture, and sell products or services in the US and Germany.

Scholars developed and applied many methods to determine criteria weights, such as those of SWARA, entropy, expert judgment, AHP, the pivot pairwise relative criteria importance assessment method, and others [50–55]. The results obtained can be applied in practice if the expert opinions are sufficiently concordant. Generally, the concordance is determined by the concordance coefficient W [56], which varies from 0 to 1 ($0 < W < 1$), but when the number of elements evaluated (in this case, methods) $m > 7$, then the concordance is established using the criterion χ^2. To calculate the criterion χ^2, only the results of ranking experts are suitable. The ranking is when the most critically evaluated element (method) is provided with a rank equal to one, the second (the least critical element (method)) is provided with a rank of two, and so on. According to significance, the last element (method) takes the rank m. The experts evaluated the significance of decision-making methods in the course of the conducted research. Therefore, based on this evaluation, the investigated methods were provided with ranks (see Tables 2 and 4).

Kendall (1955) [56] proved that expert evaluations were in concordance when the value χ^2 was higher than χ^2_{kr}, taken from the distribution table of χ^2 where the degree of freedom $\nu = m - 1$ and the selected reliability level α was close to zero (in practice, α = from 0.05 to 0.001) [57]. χ^2 is calculated according to the formula provided:

$$\chi^2 = Wr(m-1), \tag{1}$$

where W is the concordance coefficient, r is the number of experts, and m is the number of elements compared (in this case, methods). The concordance coefficient W is calculated according to the following formula [56]:

$$W = \frac{12S}{r^2 m(m^2-1)}, \text{ in this case } \chi^2 = Wr(m-1) = \frac{12S}{rm(m+1)\sum_{j=1}^{p} T_j}, \tag{2}$$

where S is the dispersion analogue, which is calculated according to the following formula:

$$S = \sum_{i=1}^{m} (e_i - \bar{e})^2. \tag{3}$$

The sum of the ranks in terms of all experts e_i is calculated according to the following formula:

$$e_i = \sum_{j=1}^{r} e_{ij}, \tag{4}$$

where e_{ij} is the jth element evaluated by the jth expert.

A deviation from the general average ē is calculated according to the following formula:

$$\bar{e} = \frac{\sum_{i=1}^{m} e_i}{m} = \frac{\sum_{i=1}^{m}\sum_{j-1}^{r} e_{ij}}{m}. \tag{5}$$

After it became clear that the results of the expert evaluations could be used in practice, the data in Tables 1 and 3 were used to determine the weights of the decision-making methods used for the R&D process.

A general idea of evaluation is presented: the most important element (in this case, methods) has determined the maximum weight, and usually the calculated weights are normalized such that

$$\sum_{i=1}^{m} g_i = 1, \tag{6}$$

where m is the number of evaluated elements (methods) and g_i is the weight of the ith element.

Next, a direct assessment of the weights of the evaluated elements (in this case, decision-making methods) determined by experts is applied. The sum of the decision-making methods evaluated by each expert is 100%. The weights g_i of the methods are calculated according to the following formula [58–60]:

$$g_i = \frac{\sum_{k=1}^{r} c_{ik}}{\sum_{i=1}^{m} \sum_{k=1}^{r} c_{ik}}, \quad (7)$$

where r is the number of experts, c_{ik} is the expert evaluation, i is the number of the series of the format, and k is the number of the expert series [61].

4. Results: Development a List of Decision-Making Methods in the R&D Process and Determination of Significance

First, the experts were asked to mark or name the methods used or known for decision making in the R&D process. At the end of the list of methods presented in the table, the experts had the opportunity to enter or name and describe a method not mentioned on the list. To supplement the list of methods, find an equivalent number of responses, and use only a qualitatively completed table of the research, 25 responses from the US experts and 25 from the German experts were selected. From the 50 experts who completed the answers to the first question, experts qualified to participate in the second stage were selected. At this stage, the experts expressed their opinions based on the MCDM method, the technique of determining the weights. In this case, qualitatively completed weight distribution tables were selected from 18 US and 18 German experts. Experts were selected from the US and German R&D organizations according to the following criteria: (1) experience in the process of technologies commercialization, the development of products or services, or in research, the subject of which is the process of technology commercialization or the development of products or services, or (2) the positions of the person in organizations and institutions responsible for the technology commercialization, development of products or services, or scientific research in the field of R&D. All specialists had at least 10 years of experience in technology commercialization. The research in the USA involved nine experts who were representatives of technology transfer centers, two start-up employees and founders, four representatives of large corporations, and three researchers studying the process of technology commercialization. In the study conducted in Germany, 1 representative of a technology transfer center, 11 start-up employees and founders, 5 representatives of big technology development companies, and 1 investor in technology projects participated.

The experts were not very active when it came to adding to the list. Only two experts from the same US organization proposed supplementing the list with the tiered voting system method, which has the voting take place across several steps. In the literature, this method is described quite modestly, too. Regarding this, Tan et al. (1995) [25] suggested that all team members first vote and then discuss the results before the next vote. Therefore, the decision was made to call this decision-making method the tiered voting system or consensus and to include it in the list of methods for weight evaluation for the US experts. The list of methods for the German experts' evaluation was also supplemented by one method: the card-sorting exercise.

The card-sorting exercise is a method for obtaining greater comprehension by developing classification [62] to engender knowledge [63] and is used in a wide spectrum of fields, including engineering, psychology, and design thinking [62]. Barett and Edwards (1995) [63] emphasized the best usage of this method being when there are many demanding solutions for one problem or vice versa. A single problem can bring several problems to light. The card-sorting exercise consists of tens of cards with descriptions of the domain entities. While explaining the criteria for sorting and creating names for each group, the participants rank the cards into categories and groups [64,65]. This technique is a tool for obtaining knowledge through interpretation by explaining the mental categories of the participants that classify problems [66] and can capture the mental models of participants [67].

In the second stage of the research, the following list of methods was submitted for expert evaluation:

1. Decisions made unilaterally (DMU);
2. The decision is based on the majority votes (DBMV);
3. The disperse team-making method (DTMM);
4. The design thinking method (DTM);
5. The Scorecard-based method (SBM);
6. A tiered voting system/consensus (TVS/C) was included in the evaluation table for the US experts, and a card-sorting exercise (CSE) was included for the German experts.

The experts expressed their opinions on the weight and suitability of different decision-making methods in the R&D process (see Tables 1 and 3). Based on the determined weight or suitability of the methods, the ranks of the decision-making methods were provided (see Tables 2 and 4), and calculations were performed. The following abbreviations are used in the tables: DMM for R&D = the decision-making methods for the R&D process, g_i = the significance of the method, SoE = the sum of evaluation, SoR = the sum of the ranks, and e_i = the sum of the ranks.

Based on the US experts' opinions, in the first position was the dispersed team-making method (DTMM), in the second position was the decision based on the majority votes (DBMV), and in third was the design thinking method (DTM). The fourth and fifth positions were occupied by decisions made unilaterally (DMU) and the tiered voting system/consensus (TVS/C), respectively. A surprising result is that for the US experts, the Scorecard-based (SBM) method was in the last position.

With reference to the findings of the conducted investigation (see Tables 1 and 2) and Formulas (1)–(5), the following results were obtained: e_i= 378.00, $\bar{e}$ = 63.00, S = 3181.50, W = 0.561, χ^2 = 50.50, ν = 5, α = 0.01, and χ^2_{kr} = 20.52. When χ^2 exceeds χ^2_{kr}, this proves that the experts' opinions are concordant, and the weights of the decision-making methods can be applied in practice.

Table 1. Determination of the weight or suitability of each decision-making method for R&D process based on the US experts.

DMM for R&D	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14	E15	E16	E17	E18	SoE	g_i
1. DMU	15	16	14	9	10	11	18	10	30	10	20	15	16	14	11	30	20	15	284	0.158
2. DBMV	16	14	20	16	32	42	20	30	5	30	21	15	14	20	32	5	21	15	368	0.204
3. DTMM	21	29	25	22	21	21	25	30	25	30	22	25	29	25	21	25	22	25	443	0.246
4. DTT	11	23	16	18	12	21	15	10	20	10	15	20	23	16	11	20	15	20	296	0.164
5. SBM	10	10	10	15	5	0	8	5	10	5	10	10	10	10	5	10	10	10	153	0.085
6. TVS/C	27	8	15	20	20	5	14	15	10	15	12	15	8	15	20	10	12	15	256	0.142
																			1800	1.000

Table 2. Ranking of research results based on the US experts.

DMM for R&D	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14	E15	E16	E17	E18	Sum of Ranks
1. DMU	4	3	5	6	5	4	3	4.5	1	4.5	3	4	3	5	4.5	1	3	4	67.50
2. DMMV	3	4	2	4	1	1	2	1.5	6	1.5	2	4	4	2	1	6	2	4	51.00
3.DTMT	2	1	1	1	2	2.5	1	1.5	2	1.5	1	1	1	1	2	2	1	1	25.50
4. DTT	5	2	3	3	4	2.5	4	4.5	3	4.5	4	2	2	3	4.5	3	4	2	60.00
5. SBM	6	5	6	5	6	6	6	6	4.5	6	6	6	5	6	6	4.5	6	6	102.00
6. CSE	1	6	4	2	3	5	5	3	4.5	3	5	4	6	4	3	4.5	5	4	72.00
																		e_i	378.00

Based on German experts' opinions, in the first position was decisions based on the majority votes (DBMV). In the second position was the disperse team-making method

(DTMM), and in third was the Scorecard-based method (SBM). The fourth and fifth positions were occupied by the card-sorting exercise (CSE) and design thinking method (DTM). The decisions made unilaterally (DMU) method among German experts was ranked in the last position.

With reference to the findings of the conducted investigation (see Tables 3 and 4) and Formulas (1)–(5), the following results were obtained: e_i= 378.00, $\bar{e}$ = 63.00, S = 2779.00, W = 0.490, χ^2 = 44.11, ν = 5, α = 0.001, and χ^2_{kr} = 20.52. When χ^2 exceeds χ^2_{kr}, this proves that the experts' opinions are concordant, and the weights of the decision-making methods can be applied in practice.

Table 3. Determination of the weights of the decision-making methods for the R&D process based on German experts.

DMM for R&D	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14	E15	E16	E17	E18	Sum of Eval.	g_i
1. DMU	1	10	8	12	12	12	5	5	10	10	5	5	7	6	11	15	9	4	147	0.082
2. DMMV	25	22	22	25	10	21	30	20	18	23	24	25	12	60	23	20	25	25	430	0.239
3. DTMT	25	20	23	17	12	19	30	20	15	23	15	25	27	10	18	16	19	22	356	0.198
4. DTT	19	12	9	16	17	15	5	15	17	8	17	5	13	8	17	14	14	16	237	0.132
5. SBM	15	19	18	12	22	21	15	20	22	17	15	25	17	3	19	18	24	24	326	0.181
6. CS	15	17	20	18	27	12	15	20	18	19	24	15	24	13	12	17	9	9	304	0.169
																			1800	1.000

Table 4. Ranking of the results of the investigation based on German experts.

DMM for R&D	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14	E15	E16	E17	E18	Sum of Ranks
1. DMU	6	6	6	5.5	4.5	5.5	5.5	6	6	5	6	5.5	6	5	6	5	5.5	6	101.00
2. DMMV	1.5	1	2	1	6	1.5	1.5	2.5	2.5	1.5	1.5	2	5	1	1	1	1	1	34.50
3. DTMT	1.5	2	1	3	4.5	3	1.5	2.5	5	1.5	5	2	1	3	3	4	3	3	49.50
4. DTT	3	5	5	4	3	4	5.5	5	4	6	3	5.5	4	4	4	6	4	4	79.00
5. SBM	4.5	3	4	5.5	2	1.5	3.5	2.5	1	4	4	2	3	6	2	2	2	2	54.50
6. TVS/C	4.5	4	3	2	1	5.5	3.5	2.5	2.5	3	1.5	4	2	2	5	3	5.5	5	59.50
																		e_i	378.00

Table 5 summarizes the two studies' weights, ranks, and weight differences of the decision-making methods in the R&D process. These reflect the differences in decision-making communication between the US and German R&D companies. Here, we can see that the most significant difference in expert opinions was for the Scorecard-based method (SBM) (−0.096) and decisions made unilaterally (DMU) (0.076). The opinions of the US and German experts differed the least for the design thinking method (DTM) (0.032) and the decision based on the majority votes (DBMV) (−0.035). The disperse team-making method (DTMM) (0.048) appeared in the middle position. Since the last methods in the list were different, the difference in expert judgments was not evaluated.

Table 5. Comparison of the weights and ranks of the decision-making methods for the R&D process based on the US and German experts.

DMM for R&D	The US		German		Differences in Weights
	Weights	Ranks	Weights	Ranks	
1	2	3	4	5	6 = 2 − 4
1. DMU	0.158	4	0.082	6	0.076
2. DBMV	0.204	2	0.239	1	−0.035
3. DTMM	0.246	1	0.198	2	0.048
4. DTM	0.164	3	0.132	5	0.032
5. SBM	0.085	6	0.181	3	−0.096
6. TVS/C and CSE	0.142	5	0.169	4	-

Regarding the first and second places, the experts' opinions were similar. According to the US experts, the DTMM method was the most important one and was in the first position, while according to the German experts, it was in the second position. Meanwhile, the DBMV method was in the first position according to the German experts but second according to the US experts. According to the US experts, the least popular method was the SBM method, and according to the German experts, the DMU method was in last.

5. Discussion

The motive behind the purpose of this article is the great academic attention to the success of R&D companies. The impact factors, various relationships between several research objects, metrics and indicators of R&D activities, etc. have been studied, but both business management and scientific communication works ignore internal communication processes and decision-making communication methods.

Considering recent research in the area of internal communication, one can notice a tendency in the internal channels and the management of internal communication analysis. Jiang et al. (2022) [68] examined the decompartmentalization of internal communication as a pretext for the employee's more successful creative processes. The results confirmed the argument stating that a high decompartmentalization of internal communication can increase the effectiveness of individual R&D workers. Lee and Kim (2021) [69] analyzed the relationship between leadership communication and symmetrical communication. The results revealed that the interaction of leadership and symmetrical communication increase employees' seeking feedback, which enhances the creativity aspect in the process.

Bizjak and Faganel (2020) [70] surveyed internal communication methods for global projects, suitable media, and communication channels for internal communication between stakeholders, focusing on cultural aspects and the importance of cultural management in global working teams. With the aim of achieving a better management idea of internal communication, Verčič and Špoljarić (2020) [71] dedicated their research to identifying how the choice of internal communication media could affect employees' internal communication satisfaction. The results showed that satisfaction directly depends on the quality of the chosen media. Similar results were obtained by Aritz et al. (2018) [72], Braun et al. (2019) [73], and Men et al. (2020) [74]. However, it is essential to mention that communication science representatives agree that internal communication is a significant factor in the success of an R&D company. However, there was a lack of determination to conduct scientific research, especially research relevant to practical considerations.

6. Observations

The results of this research have a practical implication for the communications specialist, CEO, and any R&D company. The diversity of the results could lead to the realization that leaders from different countries in different companies can use different methods for decision making. That could be a sensitive point for multicultural global companies.

Experts were taken from two different contingents, which due to experts' cultural aspects, internal companies' culture, and work conditions could disperse the results more drastically. Thus, future research could implement more experts from other contingents to compare the methods used and the diversity of the results. In addition, more different methods used in a decision-making process could be detected while researching different contingents or countries.

7. Conclusions

The ability to make decisions objectively in the technology commercialization and product development processes is a crucial step for R&D organizations. It is a game with business success which could enable technology to operate efficiently and prevent unproductive investments. Depending on the decision-making methods used, the results of the decisions can be very different and lead to very different consequences. That is why there is always a need to look deeper into the methods and tools used in all activities to achieve better results. However, in turbulent and risky R&D activities, this need increases significantly. Technology developers, especially beginners, need to make use of the experience of experienced specialists. Therefore, the decision was made using the experience of the R&D specialists to determine the suitability of decision-making methods in the R&D process.

The enumerated motives led this research to identify the most appropriate methods for making decisions in the R&D process. First, the decision-making methods in the literature were examined, and an initial list of them was prepared. Subsequently, with the help of two groups of experienced specialists from the US and Germany, the list mentioned above was supplemented, and their suitability for the R&D process was determined and presented:

1. Decisions made unilaterally (DMU);
2. The decision based on the majority votes (DBMV);
3. The disperse team-making method (DTMM);
4. The design thinking method (DTM);
5. The Scorecard-based method (SBM);
6. Tiered voting system/consensus (TVS/C), which was included in the evaluation table for the US experts;, and the card-sorting exercise (CSE), which was included for German experts.

Tables 1, 3 and 5 present a list of decision-making methods for the R&D process and research results based on the US and German experts (i.e., weights that reflect the appropriateness of the methods for decision-making for R&D). Furthermore, the differences in the evaluations of experts from these two groups were revealed, emphasizing the most significant difference for the Scorecard-based method (SBM) (−0.096) and decisions made unilaterally (DMU). For the design thinking method (DTM) (0.032) and the decision based on the majority votes (DBMV) (−0.035), expert opinions differed the least. Regarding the first and second places, the experts' opinions were similar. According to the US experts, the DTMM method was the most important method and was in the first position, while according to the German experts, it was in the second position. Meanwhile, the DBMV method was in the first position according to German experts but second according to the US experts. According to the US experts, the least popular method was the SBM method, and according to the German experts, it was the DMU method. The results reflect different experiences and differences in the conditions of the business environment.

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