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# Scientific reasoning in management. The role of abduction in research process design

Joanna Szydło
Bialystok University of Technology

## Introduction

The researcher, when commencing work, most probably has a certain amount of knowledge in the field and intends to study some particular aspects. Popper claims that research does not begin with complete ignorance, but with partial, or even erroneous, knowledge[1]. In the past, researchers referred to common, especially practical, knowledge; these days they identify problems by studying scientific literature. From publications they discover poorly-understood things or phenomena, or false or insufficiently justified statements. By finding beliefs or understandings of doubtful truthfulness they formulate questions to be resolved or state the lack of knowledge and form questions to be answered. Moreover, scientific problems are detected by observing things and phenomena. A necessary condition for detecting scientific problems is reasoning – both while reading and in the course of observation[2].

In addressing the issue of reasoning, we focus on the process of formulating a conclusion based on premises[3]. Scientific reasoning includes thought processes aimed at solving cognitive problems by deriving certain opinions from others[4].

1 K. Popper, *Conjectures and Refutations: The Growth of Scientific Knowledge*, Routledge, London 2002.

2 *Ibidem*.

3 K. Ajdukiewicz, *Język i poznanie*, vol. 2, Wydawnictwo Naukowe PWN, Warszawa 2006; J.G. Greeno, *Concepts in activities and discourses*, "Mind, Culture, and Activity" 2012, vol. 19, issue 3, pp. 310–313.

4 S. Stachak, *Podstawy metodologii nauk ekonomicznych*, Difin, Warszawa 2013, p. 164; O. Bueno, *Styles of reasoning: A pluralist view*, "Studies in History and Philosophy of Science Part

Ajdukiewicz distinguishes between simple reasoning and complex reasoning depending on whether one or more inference processes are used to solve a problem. Within simple reasoning, he distinguishes deductive (reliable), probabilistic and logically worthless reasoning. Figure 1 illustrates the division of reasoning that is logically valuable.

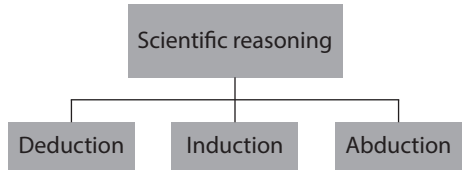


**Figure 1.** Division of reasoning

**Source:** author's elaboration.

In deductive reasoning, the premises constitute a logical rationale for the conclusion: the conclusion follows logically from the premises[5]. Probabilistic reasoning includes reductive reasoning in which the conclusion itself is a logical rationale for the premises, or in which the conclusion and some premises together become a logical rationale for other premises. Probabilistic reasoning does not guarantee the truthfulness of the conclusion. Ziembiński considers that despite the unreliability of such reasoning, in their case we have reasonable grounds to expect that with true premises the conclusion will also be true (which distinguishes probabilistic from logically worthless reasoning)[6]. This issue was well addressed by Vanharanta and Markopoulos[7], Khan and Krell[8], Nazarko[9], Sułkowski[10].

A" 2012, vol. 43(4), pp. 657–665; V. Tammik, *Appraisal of Research Depends Upon its Conceptualization*, "Integrative Psychological and Behavioral Science" 2014, vol. 48, issue 4, pp. 384–392.

5 A. Nelson, *Descartes on the limited usefulness of mathematics*, "Synthese" 2019,vol. 196, issue 9, pp. 3483–3504.

6 Z. Ziembiński, *Logika praktyczna*, Wydawnictwo Naukowe PWN, Warszawa 2006, p. 182.

7 H. Vanharanta, E. Markopoulos, *Visualization of the Wisdom Cube Scientific Knowledge Space for Management and Leadership*, "Advances in Intelligent Systems and Computing" 2020, vol. 961, pp. 14–25.

8 S. Khan, M. Krell, *Scientific Reasoning Competencies: a Case of Preservice Teacher Education*, "Canadian Journal of Science, Mathematics and Technology Education" 2019, vol. 19, issue 4, pp. 446–464.

9 J. Nazarko, *Regionalny foresight gospodarczy. Metodologia i instrumentarium badawcze*, Związek Pracodawców Warszawy i Mazowsza, Warszawa 2013.

10 Ł. Sułkowski, *Epistemologia i metodologia zarządzania*, Polskie Wydawnictwo Ekonomiczne, Warszawa 2012; Ł. Sułkowski, *Paradygmaty i teorie w naukach o zarządzaniu*, [in:] W. Czakon (ed.), *Podstawy metodologii badań w naukach o zarządzaniu*, Wydawnictwo Wolters Kluwer, Warszawa 2013, pp. 268–290.

This article is dedicated to the applications of abductive reasoning, consciously or unconsciously omitted in management sciences, by means of which we attempt to bring sense to surprising phenomena and rationalise striking events[11].

## Types of reasoning

The author used a standard bibliometric analysis of scientific literature from the Scopus database in order to characterise issues concerning scientific reasoning. Figure 2 illustrates the existence of key terms subject to a three-stage analysis.

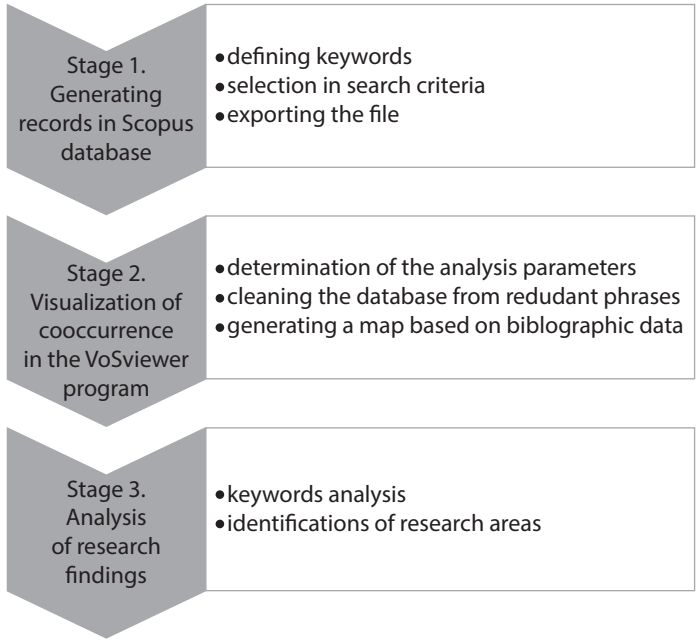


**Figure 2.** Stages of bibliometric analysis

**Source:** elaboration on the basis of E. Cichowicz, E. Rollnik-Sadowska, *Inclusive growth in CEE countries as a determinant of sustainable development*, "Sustainability" 2018, vol. 10, no. 11, 3973.

In the course of the analysis the number of articles was reduced down to 578. The author focused on such areas as 37: Social Sciences (19), Computer Science (13), Engineering (6), Economics, Econometrics, and Finance (3), Psychology (3), Business, Management, and Accounting (2), Decision Sciences (1). The tool used for data organisation and presentation was the VOSviewer programme. This software is particularly

11 M. Ciesielski, *Abdukcja w naukach o zarządzaniu*, "Przegląd Organizacji" 2014, no. 11, pp. 3–6.

useful in working on extensive volumes of data. It is a tool applied for creating and visualising bibliometric networks that use an advanced layout and clustering techniques in order to illustrate the existing references between keywords characterising articles from scientific databases. The software highlights the frequency and the co-existence of keywords that appear in the network[12]. In the second phase, the author determined such analysis parameters as a minimum number of keyword occurrences (which was 5) and, consequently, achieved a number of keywords to select from which equals 60. Cleaning the database from redundant phrases allowed for the removal of such repeated words as names of countries and phrases that failed to be thematically coherent. This fostered the creation of a map of research trends on entrepreneurial attitudes (Figure 3).

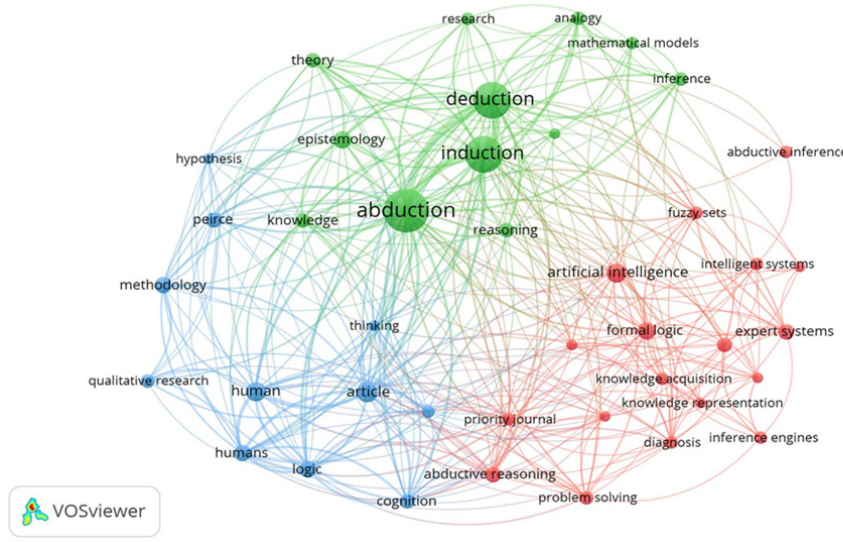


**Figure 3.** Map of research trends based on the co-occurrence of the authors' keywords in publications referring to scientific reasoning

**Source:** author's elaboration on the basis of VOSviewer software.

12 A.E. Gudanowska, *Modern research trends within technology management in the light of selected publications*, "Procedia Engineering" 2017, vol. 182, pp. 247–254; E. Glińska, D. Siemieniako, *Binge drinking in relation to services – bibliometric analysis of scientific research directions*, "Engineering Management in Production and Services" 2018, vol. 10(1), pp. 45–54; Ł. Nazarko, *Responsible Research and Innovation – a Conceptual Contribution to Theory and Practice of Technology Management*, "Business: Theory and Practice" 2019, no. 20, pp. 342–351; J. Siderska, K.S. Jadaa, *Cloud manufacturing: a service-oriented manufacturing paradigm. A review paper*, "Engineering Management in Production and Services" 2018, vol. 10(1), pp. 22–31.

The VOSviewer software allowed for distinguishing three clusters which, all together, included 35 words/phrases. The proposed cluster names relate to the majority of terms which a given cluster identified in the analysis of the co-occurrence of keywords indicated by the author. These clusters include:

- Cluster 1 – Logical reasoning – abduction, induction, deduction and related: epistemology, knowledge, research, models;
- Cluster 2 – Methodological issues – qualitative research, logic, thinking, hypotheses;
- Cluster 3 – Application of knowledge – formal logic, artificial intelligence, intelligent systems, knowledge acquisition, knowledge representation, abduction thinking, diagnosis, problem solving.

In management sciences it is possible to observe inaccuracies associated with the choice of proper reasoning[13]. Their empirical nature sometimes makes deductive reasoning inadequate to describe and evaluate the occurring phenomena. On the other hand, induction does not always allow for drawing conclusions that can be generalised. Therefore, attention was focused on abduction. Generalisations, hypotheses, laws, scientific theses do not arise as a result of a "simple" generalisation of observational sentences since they include new content – a "theoretical element", i.e. new concepts, causes, relationships that we invent or create to explain what we have observed[14].

From the initial sentences the researcher derives a sentence named a corollary or a sentence named a rationale. The corollary follows from sentences that are accepted by the rationale, while the rationale stems from sentences accepted by the corollary[15]. Deductive reasoning takes its course from the rationale to the corollary, reductive reasoning proceeds from the corollary to the rationale. The direction of deductive reasoning is the direction of a logical outcome, and the direction of reductive reasoning is the opposite (Tables 1 and 2).

In deductive reasoning, the truthfulness of the rationale is known to the researcher, of the corollary – unknown, while the corollary is (fully) justified by the rationale. In reductive reasoning, the opposite is true: the truthfulness of the rationale is unknown, of the corollary – known, and the rationale is justified (not fully) by the corollary[16].

13 W. Gasparski, *Wiedza o organizacji i zarządzaniu oraz jej poznawcze ugruntowanie*, "Współczesne Zarządzanie" 2007, no. 1, pp. 34–47.

14 J.M. Bocheński, *Współczesne metody myślenia*, Wydawnictwo W drodze, Poznań 1992, pp. 102–136.

15 K. Krajewski, *Prawa nauki. Przegląd zagadnień metodologicznych i filozoficznych*, Wydawnictwo Książka i Wiedza, Warszawa 1998, p. 74.

16 S. Stachak, *Podstawy metodologii…*, p. 164.

If the predecessor is a generalisation of the successor, then this type of reduction is called induction, but if this is not the case, then we are dealing with non-inductive reduction[17].

**Table 1.** Deductive reasoning

| If A, then B | Reasoning | The sentence is true | If employees perform their task well, they will get a bonus |
|---|---|---|---|
| A | Premise (rationale) | The predecessor is true | Employees performed their task well |
| So B | Conclusion (corollary) | So the successor is also true | So, they will get a bonus (employee X, employee Y, employee Z will get a bonus) |

**Source:** author's elaboration.

**Table 2.** Reductive reasoning

| If A, then B | Reasoning | The sentence is true | If employees perform their task well, they will get a bonus |
|---|---|---|---|
| B | Premise (corollary) | The successor is true | Employees will get a bonus |
| So A | Conclusion (rationale) | So the predecessor may be true | So – they may have performed their task well (may have performed because there might be a different reason) |

**Source:** author's elaboration.

Deduction is also referred to as "general to specific" reasoning, while induction – "from specific to general". Most often we deal with deductive reasoning in the case of mathematical models of the world, the description of which is subject to ordering. A notable example is Euclid's Elements[18]. However, rigorous adherence to deduction and the principle of maintaining the absolute truthfulness of conclusions very quickly encounters problems. An important complement to the methods of deductive reasoning involves methods of inductive and abductive reasoning.

In empirical sciences, induction is a thought process which involves deriving generalisations based on experiments or observations of facts.

This issue has been addressed by researchers since the very beginnings of humanity. However, until the end of the Middle Ages, the type of deductive reasoning proposed by Aristotle[19] was considered indisputable. The said philosopher did consider the possibility of inductive reasoning, but only in the form of complete

17 J.M. Bocheński, *Współczesne metody…*, p. 103.

18 P. Błaszczyk, K. Mrówka, *Euklides, "Elementy". Księgi V–VI*, http://www.eudoxos.pl/wp-content/uploads/2013/04/Euklides_V_VI.pdf (accessed: 15.07.2019).

19 Arystoteles, *Dzieła wszystkie*, vol. 1, Wydawnictwo Naukowe PWN, Warszawa 2003.

enumerative induction[20]. The certainty of inductive reasoning is only complete when all cases can be investigated, which is quite unlikely in the research process. Bacon[21], Hume[22], Kant[23], Mill[24], Leake[25] devoted considerable attention to this problem.

Bacon brought development in the enumerative induction outlined by Aristotle by proposing a simple calculation procedure – incomplete induction. The more positive instances empirical generalisations have, the more supported they are. Incomplete induction is based on deriving approximate statements with the same degree of probability as was observed during the observations of individual specimens. It can be concluded that the more facts, events or processes are investigated, the more correct (true) an inductive conclusion is. Inductive conclusions are by their nature inaccurate. They are based on people's innate ability to find patterns and rules on the basis of a finite (and perhaps incomplete and inaccurate) sample derived from the observation. Incomplete induction is used for three reasons[26]:

- unavailability of certain facts;
- the need to reduce the cost of research;
- obtaining test results in an unrealistically short time.

Bacon also initiated divagations on eliminative induction, which Mill later developed. Eliminative induction not only involves a simple compilation of certain facts, but also grouping them into specific systems. This is possible thanks to five methods of causal inference. These were called canons of induction or Mill's canons and are still widely recognised (the method of agreement, the method of difference, the method of agreement and difference, the method of residues and the method of concomitant variations). They make it possible to find cause-and-effect relationships between particular events, phenomena, features or their elements[27] (Table 3).

20 Z. Hajduk, *Ogólna metodologia nauk*, Wydawnictwo Katolickiego Uniwersytetu Lubelskiego, Lublin 2001.

21 F. Bacon, *Novum Organum*, serie: Biblioteka Klasyków Filozofii, PWN, Warszawa 1955.

22 D. Hume, *A Treatise of Human Nature*, Clarendon Press, Oxford 1965, http://snd.hegemonikon.pl/wp-content/uploads/2016/03/David-Hume-Traktat-o-naturze-ludzkiej3.pdf (accessed: 8.07.2019).

23 I. Kant, *Krytyka czystego rozumu*, https://wolnelektury.pl/media/book/pdf/krytyka-czystego-rozumu.pdf (accessed: 6.05.2019).

24 J.S. Mill, *System logiki dedukcyjnej i indukcyjnej*, vol. 1, serie: Biblioteka Klasyków Filozofii, PWN, Warszawa 1962.

25 D.B. Leake, *Abduction, Experience and Goals: A Model of Everyday Abductive Explanation*, "The Journal of Experimental and Theoretical Artificial Inteligence" 1995, no. 7, pp. 407–428.

26 S. Stachak, *Podstawy metodologii…*, p. 172.

27 J.M. Bocheński, *Współczesne metody…*, p. 119.

**Table 3.** Inductive reasoning

| If A, then B | Reasoning | The sentence is true | If employees perform their task well, they will get a bonus |
|---|---|---|---|
| **Example 1 Complete induction** | Observation | Fact | Employee X will get a bonus<br>Employee Y will get a bonus<br>Employee Z will get a bonus |
| | Observation | Fact | Employee X performed their task well<br>Employee Y performed their task well<br>Employee Z performed their task well |
| **B** | **Premise (corollary)** | **The successor is true** | **Employees will get a bonus** |
| **So A** | **Conclusion (rationale)** | **So the predecessor is true** | **So – they performed their task well** |
| **Question** | **What justifies truthfulness?** | | |
| **Example 2 Incomplete induction** | Observation | Fact | Employee X will get a bonus<br>Employee Y will get a bonus<br>Employee Z will get a bonus |
| | Observation<br>**Observation impossible** | Fact | Employee X performed their task well<br>Employee Y performed their task well<br>**Employee Z?** |
| **B** | **Premise (corollary)** | **The successor is true** | **Employees will get a bonus** |
| **So A** | **Conclusion (rationale)** | **So the predecessor may be true** | **So – they may have performed their task well (may have performed because there might be a different reason)** |
| **Question** | **What justifies truthfulness?** | | |
| **Example 3 Eliminative induction** | Observation stage 1 | Fact | Employee X will get a bonus<br>Employee Y will get a bonus |
| | Observation stage 2 | Fact | Employee X will get a bonus<br>Employee Z will get a bonus |
| | Observation | Fact + elimination of repetitive (inconsistent) observations | **Employee X performed their task well** |
| **B** | **Premise (corollary)** | **The successor is true** | **Employees will get a bonus** |
| **So A** | **Conclusion (rationale)** | **So the predecessor may be true** | **So – employee X may be performing their tasks well because they got another bonus** |
| **Question** | **Why is the statement likely/possible?** | | |

**Source:** author's elaboration.

Hume and Kant brought incomplete eliminative induction under critical analysis. Hume proposed a new approach, which is an alternative stating that either knowledge is certain and concerns ideas (abstracts, e.g. mathematical objects), or it is uncertain and concerns facts from reality. He took a negative stance towards

justifying inductive conclusions, assuming that they are not the results of reasoning, but of a habit, as correlates of generated associations. Kant believed that not only is the transition from single to general sentences inductive, but also every non-formal form of deriving general statements.

Modern understanding of inductive reasoning has drifted away from Kant and Hume's ideas towards inductive logics, which, instead of answering the question "what justifies truthfulness?" attempt to answer the question "why is the statement likely/possible?". This type of approach was represented, among others, by Carnap[28].

Abduction is, to a great extent, the logic of the context of the discovery. Although it is believed that Pace was the first to use this term, it is Peirce who is considered to be the forerunner of contemporary research on abduction[29]. Abduction is reasoning in which we strive (as best we can) to explain surprising phenomena. It is defined in such a manner, among others, by Aliseda[30], Hintikka[31], Josephson and Josephson[32], Leake[33], Thagard[34], Urbański[35], Minnameier[36].

Let us say we have observed an event and then wish to find out why it occurred, or why it was as such and not different. In management sciences, this type of reasoning is often unconsciously used by researchers. A good practical example is the Mayo experiments, described in every textbook on management sciences. He observed a "strange phenomenon" – as working conditions worsened, the productivity of the workers increased. Mayo formulated a series of abductive hypotheses. The hypothesis which was the best explanation initiated the so-called trend of interpersonal relations in management sciences[37]. An exemplary scheme of abductive reasoning is illustrated in Table 4.

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28 L. Carnap, *Logiczna struktura świata*, Wydawnictwo Naukowe PWN, Warszawa 2011.

29 M. Urbański, *Paula Thagarda konepcja rozumowania*, "Studia z Kognitywistyki i Filozofii Umysłu" 2012, vol. 6(1), pp. 97–120.

30 A. Aliseda, *The Logic of Abduction: An Introduction*, Springer Handbooks, Heidelberg – Berlin 2017, pp. 219–230; A. Aliseda, *Abductive Reasoning. Logical Investigations into Discovery and Explanation*, Springer, Dordrecht 2006.

31 J. Hintikka, *What is abduction? The fundamental problem of contemporary epistemology*, "Trans-actions of Charles S. Peirce Society" 1998, vol. 34(3), pp. 503–533.

32 J.R. Josephson, S.G. Josephson (eds), *Abductive Inference: Computation, Philosophy, Technology*, Cambridge University Press, Cambridge 1994.

33 D.B. Leake, *Abduction, Experience and Goals…*

34 P. Thagard, *Computational Philosophy Science*, MIT Press, Cambridge 1998.

35 M. Urbański, *Paula Thagarda konepcja…*

36 G. Minnameier, *Forms of abduction and an inferential taxonomy*, [in:] L. Magnani, T. Bertolotti (eds), *Handbook of model-based science*, Springer, Berlin 2017, pp. 175–195.

37 M. Ciesielski, *Abdukcja w naukach…*, p. 4.

**Table 4.** Abductive reasoning

| | | | |
|---|---|---|---|
| B | Phenomenon | Observed phenomenon is true | Employees got a bonus |
| If A then B | Hypothesis | Sentence is true | If employees perform their task well, they will get a bonus |
| So A | Conclusion (about the causes of the event) | The predecessor is most likely to be true | Employees performed their task well (employee X, employee Y, employee Z performed their task well) |

**Source:** author's elaboration.

The abductive method involves seeking a hypothesis from which one can deduce that a given phenomenon will occur when faced with a surprising phenomenon. If such a hypothesis were true, the seemingly mysterious phenomenon would be completely natural. Therefore, when such a hypothesis is found, it should be concluded that it is probably true. If there is more than one hypothesis, one should choose the one that provides a better explanation than the others. This principle is called the principle of inference in order to obtain the best explanation[38].

The abductive structure can be presented as follows:

- We observe a surprising phenomenon B
- If A were true, then the occurrence of B would be obvious
- So we have the reason to suspect that A is real[39].

Abduction is described as a two-phase process where the generation of abduction hypotheses constitutes phase one. Supported by knowledge, experience and intuition, the ability to observe is helpful in generating hypotheses, but does not guarantee their accuracy: hypotheses are, in fact, always just guesses. Phase two is the evaluation of these hypotheses. In this way the structure of the second phase of abduction adequately describes the scheme of eliminative induction: we reject unreliable hypotheses out of all the competitive hypotheses A1, A2, ..., AN. Those that remain should solve the abductive problem. "If we consider all hypotheses and reject the impossible, what remains,

38 A. Grobler, *Metodologia nauk*, Wydawnictwo Aureus, Wydawnictwo Znak, Kraków 2008, p. 102; M. Vitti Rodrigues, C. Emmeche, *Abduction and styles of scientific thinking*, "Synthese" 2019, https://www.cle.unicamp.br/index.php/sites/default/files/2019_MVR_CE_Styles_Abd.pdf (accessed: 6.05.2019); D.G. Campos, *On the distinction between Peirce's abduction and Lipton's Inference to the best explanation*, "Synthese" 2011, vol. 180(3), pp. 419–442; S. Paavola, *Fibers of Abduction*, [in:] T. Thellefsen, B. Sorensen (eds), *Charles Sanders Peirce in his own words: 100 years of semiotics, communication and cognition*, Walther de Gruyter, Berlin 2014, pp. 365–372.

39 M. Urbański, *Paula Thagarda konepcja*…, p. 20.

however improbable, must be true"[40]. Abduction allows to reach conclusions with regard to the potential causes of events. Abduction is the logic of the context of the discovery.

## Abduction diagram

One can put forward arguments in favour of the complementarity of abduction as opposed to induction and deduction. The author of the idea of abductive reasoning, Peirce, proposed: "based on what is suggested by abduction, deduction creates forecasts that can be tested by induction". He believed, therefore, that abduction, deduction and induction are the three stages of a single research method, of which abduction is the initial stage. The full model assumes the following form: **data (facts) – abduction – hypotheses – complete enumerative induction/deduction – forecasts – induction – data (facts)**. Figure 4 presents the abduction diagram.

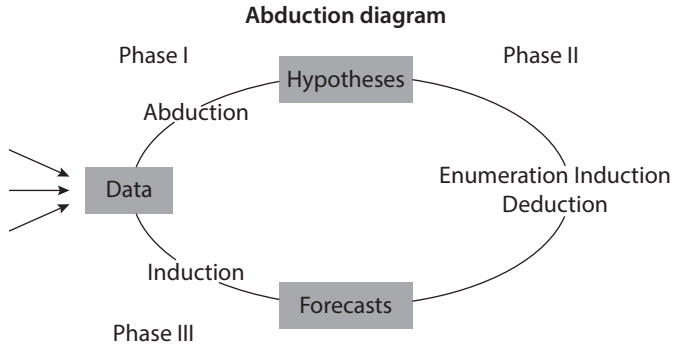


**Figure 4.** Abduction diagram

**Source:** author's elaboration on the basis of M. Ciesielski, *Abdukcja w naukach…*, p. 5; Ch. Hartshorne, P. Weiss (eds), *Collected Papers of Charles Sanders Peirce*, Harvard University Press, Cambridge 1931.

Here we deal with a three-phase process. The generation of abductive hypotheses constitutes phase one, which is not, in fact, reliable reasoning. The ability to observe, supported by knowledge, experience and intuition, is helpful in generating hypotheses but does not guarantee their accuracy. Hypotheses are in fact always plain guesses. In contrast, phase two is the evaluation of hypotheses. In a simple case, it may happen that the hypotheses generated in phase one are evaluated. The second phase of abduction adequately describes the scheme of eliminative induction in which we reject the unbelievable hypotheses out of all competitive ones: A1, A2, ..., AN. Those that remain should solve our abductive problem. The first

40 *Ibidem*, p. 163.

phase of abductive reasoning – the generation of hypotheses – is therefore certainly of a substantiating character. On the other hand, if the second phase follows the scheme of complete eliminative induction, from a formal point of view it is also deductive reasoning[41]. The hypothesis is then a reliable conclusion, deductively derived from the premises. At the next stage we can proceed to phase three – the examination of individual cases in order to verify the hypothesis.

Ciesielski observes that the lack of knowledge on the principles of abductive reasoning often leads to errors – mainly in the selection and stratification of a set of examined factors. He also adds that the cognitive scheme that includes abduction, deduction and induction – in a logical arrangement and relationship – is helpful in conducting the research process in the discussed discipline[42].

## Conclusions

From the time of Carnap knowledge in social sciences has consisted of a descriptive (observation of socio-economic phenomena) and a theoretical – or, explanatory – layer. Scientific knowledge speaks two languages: it is the language of observation – defining directly observable phenomena and concepts – and the language of theory, which consists of inferred concepts that are intended to explain directly-observed phenomena[43]. It seems that hypotheses are related to the adoption of such a way of conducting science[44]. Creating hypotheses uncovers deeper problems faced by the discipline of management sciences[45]. Therefore, a conscious use of abductive reasoning may help to overcome these problems.

The deepening of merit-based knowledge in a given discipline should go hand in hand with methodological reflection and the development of a methodological workshop.

Management as a science that researches the social and economic sphere is, by definition, on the borderline of many disciplines, which predisposes it to reflect on the choice of the right form of reasoning. The number of cognitive and practical problems of the world of organisations forces the absorption of new instruments.

41 *Ibidem*, p. 168.

42 M. Ciesielski, *Abdukcja w naukach…*, p. 3.

43 S. Nowak, *Metodologia badań społecznych*, Wydawnictwo Naukowe PWN, Warszawa 2007, p. 75.

44 A.M. Jeszka, *Problemy badawcze i hipotezy w naukach o zarządzaniu*, "Organizacja i Kierowanie/Organization and Management" 2013, no. 5(158), pp. 31–39.

45 C. Frankfort-Nachmias, D. Nachmias, E. Hornowska, *Metody badawcze w naukach społecznych*, Zysk i S-ka, Poznań 2001, p. 35.

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Bacon F., *Novum Organum*, serie: Biblioteka Klasyków Filozofii, PWN, Warszawa 1955.

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Campos D.G., *On the distinction between Peirce's abduction and Lipton's Inference to the best explanation*, "Synthese" 2011, vol. 180(3), pp. 419–442.

Carnap L., *Logiczna struktura świata*, Wydawnictwo Naukowe PWN, Warszawa 2011.

Cichowicz E., Rollnik-Sadowska E., *Inclusive growth in CEE countries as a determinant of sustainable development*, "Sustainability" 2018, vol. 10, no. 11, 3973.

Ciesielski M., *Abdukcja w naukach o zarządzaniu*, "Przegląd Organizacji" 2014, no. 11, pp. 3–6.

Frankfort-Nachmias C., Nachmias D., Hornowska E., *Metody badawcze w naukach społecznych*, Zysk i S-ka, Poznań 2001.

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## Abstract

Management as a science that studies the social and economic sphere exists, by definition, on the borderline of many disciplines, which predisposes it to undertake considerations relating to the choice of the right way of thinking. The subject discussed in the text is hardly explored in management sciences, but it is very important due to the consequences resulting from the adoption of wrong methodological assumptions. Although the article is theoretical by nature, it raises significant issues concerning the preparation of the research process. The aim of the article is to broaden researchers' awareness of the application of scientific reasoning.

The empirical nature of management sciences makes deductive reasoning not always adequate for the description and evaluation of occurring phenomena, whereas inductive reasoning does not allow for drawing conclusions that can be generalised. Therefore, attention was focused on abduction. The author presents arguments for the complementarity of abduction as opposed to induction and deduction as well as a scheme of abductive reasoning.

It has been recognised that the number of cognitive and practical problems in the world of organisations forces the absorption of new instruments.

**Keywords:** scientific reasoning, deduction, induction, abduction, abduction diagram