



Phronetic Leadership Style Evaluation with a Fuzzy Logic Application

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The purpose of leadership style assessments is to determine the basic features and characteristics of leadership behaviors and to reveal the leader's personality traits and abilities and to increase their self-awareness. The style can be, for example, democratic, autocratic, bureaucratic, laissez-faire, strategic, visionary, transformational, or transactional. However, ordinary assessments do not help leaders analyze their knowledge and wisdom behind their behaviors. The Wisdom Cube seeks to explain wisdom through the four dimensions of wisdom and provides a practical way of understanding the knowledge and wisdom in leadership. By utilizing the dimensions and planes of the Wisdom Cube, we can find the way from data handling, information processing, and knowledge creation to wisdom generation. The aim of this research is, therefore, to reveal the ontology of the phronetic leader and to create a practical evaluation tool for leaders. The content of the article covers the elements of the Wisdom Cube, presents related efforts to measure and analyze phronetic leadership characteristics, and shows the practical results of the first test runs with the fuzzy logic-based application. The personal deep understanding of the leadership traits may then help the leaders to turn their current leadership styles more phronetic.

Keywords: Application; Fuzzy Logic; Phronetic; Leaders; Ontologies; Traits

1. Introduction

Individuals, companies, and societies seek sensible, wise decisions in changing circumstances. The targets of supply activities are to manage the demands of human, business, and societal needs.

Supply and demand are facing both challenges and opportunities in the added-value markets of the world and societies. The creation of economic added value in an organization, whether public or private, in a turbulent business environment, requires more and more from leaders and organizations. There are many ways to support leaders and managers as well as many methodologies and methods to help to improve the productivity and performance of those who make the final decisions on how the world is changing and how added value is created in companies and societies for shared added-value. The assessment of current leadership competencies and traits is therefore important. It is also essential to know the degree of knowledge and wise leadership traits within the companies. Supply and demand in the economic added-value context describe many of the bounded rationality variables and space in leaders' and managers' decision-making environment (See Figure 1). A lot of knowledge and wisdom are needed to tackle opportunities, risks, objectives, challenges for the benefit of the organization managers and leaders are serving.

Insert Figure 1 about here.

Previous research by Hambrick and Mason (1984) has synthesized fragmented literature from various fields to create a theoretical framework and model (An upper Echelons Perspective of Organization), which states that organizational outcomes are partially predicted by managerial background characteristics, i.e. psychological as well as observable characteristics of upper echelons. Observable characteristics cover age, functional track, career experiences, formal education, socioeconomic background, financial position, and group heterogeneity. Psychological characteristics, in turn, cover cognitive base and values. With these characteristics, decision-makers

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3 create strategic choices, which then lead to organizational performance: profitability, growth, and
4 survival. Hambrick's and Mason's research contain 21 development propositions to support their
5 theoretical framework and these propositions suit partly also to the objectives and goals presented in
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10 Figure 1.

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12 The presented views and propositions, however, don't touch the current space of leadership
13 knowledge and not either the leadership wisdom behind the needed decisions. For us, data mining,
14 information retrieval as well as knowledge discovery are the main variables to increase human
15 perception, interpretation and deep understanding in different business situations. We have
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21 therefore looked more the overall process: how to increase knowledge and wisdom to support
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24 decision-makers.

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26 In this research, we started to explore these upper echelon characteristics and traits on the
27 basis of the thinking and writings of the ancient philosophers (Aristotle, 1999; Buckingham et al.
28 2011; Magee, 2016). We also used modern interpretations of the meanings of these texts (Ardelt,
29 2004; Baehr, 2014; Wittmer, 2013). This methodology gave us the chance to reveal the basic
30 principles, constructs, and concepts of an ontology that we could convert into a fuzzy logic-based
31 application for evaluating new leadership competencies, wise leadership traits, and styles. In the
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end, we used the Wisdom Cube framework for our application development work concerning the
phronetic leadership style. With the presented application (Leda), managers and leaders can
evaluate their current status and degree of phronetic leader characteristics, as well as envisioning
the targeted future traits with the well-known concept of creative tension (Senge, 1990). This
research presents, therefore, a novel way to combine data, information, knowledge, and wisdom
(DIKW) as a concrete new model, which then is used to find out cognitive faculties of upper
echelons in current as well as the future targeted state. The context in our work is management and
leadership in business, but the results can also be used for other contexts such as societal or
governmental.

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3 This paper aims to answer to following questions: How to model dimensions and relations
4 of wisdom into an ontology-based on ancient Greek philosophers? How to utilize the Wisdom Cube
5 framework in assessing leadership characteristics? How to use the assessment results to increase the
6 leaders' self- and the organization's collective-awareness?
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12 The paper is divided into five main chapters as follows: Introduction, Dimensions of
13 Knowledge and Wisdom, Traits of Phronetic Leader, Ontology of the Phronetic Leader,
14 Technology and the Application Used, Test Results with the Application, Discussion, and
15 Conclusions, as well as a short Future Research chapter.
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22 **2. Dimensions of Knowledge and Wisdom**

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24 Our starting point in this research has been Episteme, Sophia, Techne, and Phronesis, which were
25 the main dimensions when wisdom was defined and articulated by the Ancient Philosophers
26 hundreds of years ago (Buckingham et al. 2011). Each dimension has its own specific content and
27 the boundaries with the others are often fuzzy by nature (cf. Trillas, 2011).
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34 **2.1. Episteme**

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36 Episteme is an Ancient Greek word ἐπιστήμη *Epistēmē* most often translated as knowledge
37 (Parry, 2014). It is based on the verb ἐπίστασθαι, meaning to know, to understand, to be acquainted
38 with.
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45 Aristotle has described more episteme in his Nicomachean Ethics (Aristotle, 1999):

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47 *“Scientific knowledge is about things that are universal and necessary, and the conclusions of*
48 *demonstrations and all scientific knowledge follow from first principles (for scientific knowledge*
49 *involves apprehension of the rational ground). This being so, the first principle from which what is*
50 *scientifically known follows cannot be an object of scientific knowledge, of art, or of practical*
51 *wisdom; for that which can be scientifically known can be demonstrated, and art and practical*
52 *wisdom deal with things that are variable.”*
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3 In other words, what is scientifically known and true is invariable in time and space and can
4
5 be demonstrated, and so things which are variable belong more to the areas of art, practical
6
7 knowledge, and wisdom.
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10 From the above, we can conclude in our context that taking Episteme, the scientific
11
12 dimension of knowledge and wisdom, as a basis now demands a totally new type of teachable
13
14 business knowledge regarding management and leadership. We have to show and demonstrate
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16 better and better the fundamentals so that we obtain more universal as well as necessary knowledge
17
18 for management and leadership purposes. Although these are very demanding requirements in the
19
20 social sciences, we believe that it is nevertheless natural and also practical to take the Episteme
21
22 dimension, content, and direction into more profound consideration than before, especially if we use
23
24 the other wisdom dimensions of Sophia, Techne, and Phronesis in business evaluations. Better
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26 scientific touch and understanding of Episteme will support and improve the other areas of
27
28 knowledge and wisdom creation.
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33 In the management and leadership context, Episteme is, therefore, an important basis for our
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35 thinking; however, we cannot follow principles which are valid in the natural sciences. We can only
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37 apply scientific knowledge in this context and suppose that in some things and issues we can reach
38
39 an understanding level in our knowing that it is not even capable of being otherwise (cf. Aristotle,
40
41 1999). Therefore, the aspiration for scientific knowledge, Episteme, is also a necessity in the
42
43 context of management and leadership. However, we understand that there are difficulties finding
44
45 the knowledge that is context-independent, invariable, necessary, and universal. The scientific
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47 knowledge created in Episteme is based normally on general analytical rationality and the starting
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49 point is human intuition. The target is always to know and to create knowledge, i.e., “justified true
50
51 belief”, which will be then as close as possible to the demands of Episteme (cf. Aristotle, 1999).
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57 **2.2. Sophia**

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59 The Ancient Greek word *Sophia* (σοφία, *sophía*) is the abstract noun of σοφός (*sophós*), which has
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2
3 been variously described by the words skillful, able, intelligent, clever, cunning, prudent, wise, all
4
5 of which characterize human traits. Sophia has also been described by Baehr in a wider context as
6
7 the epistemic state concept, the cognitive faculty concept as well as intellectual trait concept (Baehr,
8
9 2014). Baehr also takes a wider perspective than Aristotle of the dimension of Sophia and calls it
10
11 the theoretical dimension of wisdom (Baehr, 2014). He combines Episteme and Sophia by saying
12
13 that the target in Sophia is “deep explanatory understanding of epistemically significant subject
14
15 matter”. This theoretical knowledge dimension has thus also been described as knowledge of “why”
16
17 something is true. All this means that it is necessary for the human mind to find explanations to
18
19 state why certain truths are true. A deep understanding is then necessary, which requires reasoning
20
21 concerning universal truths. Abstract concepts make this reasoning difficult and often the results do
22
23 not fulfill all the requirements in the business management and leadership context. The question
24
25 “why” is therefore extremely important because it can open the way to a deep understanding of
26
27 viable systems, abstract business constructs and concepts with many variables and indicators. Many
28
29 cause-and-effect relationships and interrelationships are also difficult to observe without clever,
30
31 skillful, intelligent, and wise managers and leaders. However, this is not enough because knowledge
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33 also needs clear background theories, methodologies, and methods, which help managers and
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35 leaders to make important connections with quantitative data and qualitative information for their
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37 knowledge creation and wisdom before any decision making.
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46 **2.3. *Techne***

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48 A widespread definition of the meaning of *Techne* (Ancient Greek: τέχνη) comes from Aristotle’s
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50 texts. Aristotle saw it as “representative of the imperfection of human imitation of nature”
51
52 (Aristotle, 1999). There are many examples that describe *Techne* as an activity that is concrete,
53
54 variable, and context-dependent. *Techne* is both craft and art. Carpentry has been mentioned in
55
56 Aristotle’s texts as an example of *Techne*, as well as sciences like medicine and arithmetic. Often,
57
58 *Techne* is thought of as more productive than theoretical, but *Techne* reveals its nature when people
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3 wish to obtain data and information concerning how to do something, i.e., technical knowledge and
4
5 know-how. It is also interesting that it fulfills the requirement of Episteme that it can be taught.
6
7 This, in turn, is related to the people who are behind this knowledge and wisdom. Techne has
8
9 connections to people who can make, know what is needed, know when the need exists, and also
10
11 the context where something is needed. Techne is therefore close not only to Phronesis, the
12
13 practical dimension of wisdom but also to scientific Episteme and theoretical Sophia. Techne also
14
15 has connections with communication, since people are connected to their cultures and communicate
16
17 what they are going to do or make. Human skills, ability, capacity, capability, competence,
18
19 commitment, and motivation show what a person is going to do and make. Techne aims at deeds, on
20
21 a scale of duties and wants, where an activity or making something leads to an end or an end
22
23 product (cf. von Wright, 1980). Techne is close to the terms: technique, technical, and technology,
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25 leading to production activities, i.e., inputs, processes, and outputs, as well as other mechanical or
26
27 material components of real-world systems (cf. Aristotle, 1999).
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34 **2.4. Phronesis**

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37 Practical wisdom, Phronesis, is the fourth dimension of wisdom in the Wisdom Cube. It is an
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39 Ancient Greek word for a type of practical wisdom or intelligence (Ancient Greek: φρόνησις,
40
41 *phrónēsis*). In his book, *Nicomachean Ethics*, Aristotle approaches Phronesis separately as one
42
43 important area of wisdom (Aristotle, 1999). It describes dynamic and action-oriented knowledge
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45 and wisdom, but it also includes the capability as well as competence of rational thinking. Phronesis
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47 is based on practical value-rationality and the created knowledge is variable (not invariable)
48
49 because it is very much a context- and situation-dependent dimension of knowledge and wisdom.
50
51 Phronesis emphasizes deliberation about ethics and values with reference to practical needs. In
52
53 business management and leadership, added and shared values constitute increased value, which the
54
55 organization can produce for humankind with both its human intelligence and its fixed assets. One
56
57 sub-dimension of Phronesis is looking ahead to or envisioning the future, i.e., the “power of
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3 foresight” (Aristotle, 1999), which is something which people trust to be important in their current
4
5 situation. This wisdom often emerges when people know how to progress and also when they are
6
7 capable of showing how to progress. Much of this wisdom and knowledge is connected to intuitive
8
9 thinking in a specific context and situation and so we understand that Phronesis has connections to
10
11 Episteme, Sophia, and Techne. Its pragmatic nature, common sense, serves people well and
12
13 deliberation of ethics and values keeps it close to daily life. This dimension of wisdom is therefore
14
15 very important in daily management and leadership when deep understanding and deliberation are
16
17 needed (cf. Aristotle, 1999).
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21 “Practical wisdom, on the other hand, is concerned with things human and things about
22
23 which it is possible to deliberate; for we say this is above all the work of the man of practical
24
25 wisdom, to deliberate well, but no one deliberates about things invariable, nor about things which
26
27 have not an end, and that a good that can be brought about by action” (Aristotle, 1999).
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31 **2.5. The Wisdom Cube**

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33 The dimensions of wisdom can be visualized with the Wisdom Cube in the way that each of the
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35 dimensions briefly describes the main characteristics. See Figure 2.
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42 Insert Figure 2 about here.
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46 From the Wisdom Cube, we can discover the planes which cover the contents of each
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48 dimension belonging to the plane. See Figure 3.
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54 Insert Figure 3 about here.
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58 Figure 3 very clearly shows that breaking down the construct into different characteristics
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60 helps us understand the nature of wisdom and it also shows how important it is to use this created

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3 knowledge for teaching purposes as well as for development purposes in the management and
4
5 leadership context. Figure 3 allows us to go further and penetrate deeper into the secrets of business
6
7 knowledge in the specific context we have taken. Humans behave as active members inside this
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9 Space of Wisdom, as entities, i.e., as living systems (Miller, 1978).

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12 The Planes and Space of Wisdom show that the Ancient Philosophers reached a deep level
13
14 of understanding that gives us great opportunities now to see ourselves as members and owners of
15
16 that ‘big knowledge and wisdom’. The degree of wisdom in each plane can describe an individual’s
17
18 position in the overall universal Space of Wisdom. A strong scientific, theoretical, and technical
19
20 understanding and education throughout the Planes of Wisdom make important paths for managers
21
22 and leaders to attain a strong position in their organization. They should place and position
23
24 themselves with the current understanding and then use their creative tension to move from that
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26 position to a future position (cf. Senge, 1990).
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32 **3. Traits of the Phronetic Leader**

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35 Phronetic leadership has long been a paradigm for wise practical leadership and there have been
36
37 many different ideas and models on how to develop the traits of leaders and managers to reach the
38
39 level of wise leadership.
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42 Following the origin of practical wisdom by Aristotle, Ikujiro Nonaka and Hirotaka
43
44 Takeuchi have described phronetic leaders with six different abilities (abilities to lead wisely)
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46 (Nonaka & Takeuchi, 2011): 1) Wise leaders can judge goodness, which means that leaders
47
48 exercise moral sensitivity, target the common good, and see the company as being in harmony with
49
50 the society; 2) Wise leaders can grasp the essence, which means that leaders understand the current
51
52 business situation and actions needed. They sense the essential and clarify the nature and meaning
53
54 of people, things, and events intuitively. From the Episteme dimension, they should also grasp the
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56 universal truths from the important particulars and details, as Aristotle teaches us; 3) Wise leaders
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58 create shared contexts, which means that the leaders create learning environments for employees in
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3 which relationships are strengthened and interactions initiated; 4) Wise leaders communicate the
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5 essence, which means that leaders communicate in an understandable way and give the big picture
6
7 of the business to the members of their organization. They also use storytelling and metaphors
8
9 effectively. They have the ability to grasp relationships and interrelationships between one thing
10
11 and another. They understand well the past, present, and visions of the future. They naturally come
12
13 down to the shop floor and communicate easily with company employees. They show clearly that
14
15 they are committed and engaged with the personnel and the company; 5) Wise leaders exercise
16
17 political power, which means uniting people to take action using all the means suited to the
18
19 situation and understanding human nature both bad and good, optimism and pessimism, civility and
20
21 incivility, diligence and laziness. Wise leaders master dialectical thinking, which gives them
22
23 possibilities to deal with dichotomies, contradictions, opposites, and paradoxes. Using imagination,
24
25 insights, and envisioning they can reach higher conceptual levels; 6) Wise leaders foster practical
26
27 wisdom in others, which means that leaders facilitate the distribution of practical wisdom as much
28
29 as possible in the organization and teach members to use wisdom. Companies can then respond
30
31 flexibly and creatively to any situation and change.
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37 In his article “World Awaits Phronetic Business Leaders”, Manu Melwin Joy, following the
38
39 six quality models of Nonaka and Takeuchi, has also presented role models of persons who have or
40
41 have had the above-mentioned leadership traits like Soichiro Honda, Ratan Tata, Martin Luther
42
43 King, Steve Jobs, F. Scott Fitzgerald (cf. Joy, 2017).
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47 Thomas Shinto (Shinto, 2017) has also used the Aristotelian concept of practical wisdom
48
49 (Phronesis) in his attempt to show how important it is that phronetic attributes are taken into
50
51 account to support the professional excellence of modern managers. His Phronetic Professional
52
53 Excellence model (PPE), based on an ancient and modern interpretation of Phronesis, has been
54
55 constructed with five different characteristics:
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58 Base > Phronesis operates on the basis of values and virtues
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3 Formation > Phronesis is a dynamic interplay of conjoint enablers like Praxis, Personality,
4
5 Cognition, Perception, and Deliberation
6

7 Action > Phronesis is action-oriented and holds the manager accountable for the best
8
9 management of men, resources, and operations
10

11 Result > Phronesis is result-oriented to achieve the optimum results in organizational,
12
13 operational, and individual realms
14

15 Vision > Phronesis is vision-oriented with insights into what is of ultimate and proximate
16
17 good for all.
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19 According Thomas, the main system boundary of his PPE model consists of Phronesis,
20
21 Culture, and Environment. The operational part with praxis, personality, cognition, perception, and
22
23 deliberation lies around the core of value and virtue. The operational part covers all the accountable
24
25 issues in management and leadership culminating ultimately in the results of management and
26
27 leadership in terms of organizational, operational, as well as individual results. The ultimate goal is
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29 to reach lasting “goodness”.
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34 Thomas expands the content of the abilities presented by Nonaka and Takeuchi with
35
36 competence thinking. The essential abilities required for being a phronetic leader, according to
37
38 Thomas, contain the following competencies:
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41 Conceptual competence > Mindfulness, use of concepts, Systems thinking, Pattern
42
43 recognition, and Tacit knowledge
44

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46 Emotional competence > Intrapersonal intelligence, Interpersonal intelligence
47

48
49 Technical competence > Technical proficiency, Knowledge sharing & networks,
50
51 Information management, Continuous learning and development, Coaching
52

53
54 Ontological competence > Ability to see the meaning of existence beyond concrete reality,
55
56 Happiness, Love of wisdom, Freedom, Passion, Good of all, Harmony between the individual good
57
58 and universal good, Metacognitive intelligence, and Existential intelligence.
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3 Thomas's PPE model supports Nonaka and Takeuchi's thinking about abilities very well
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5 and puts everything inside a dynamic and visual model which aids overall understanding. However,
6
7 the measurement of these abilities, characteristics, and competences has not been revealed by any
8
9 means and the final structure of human capacity, potentiality, skills, abilities, capabilities, and
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11 competencies have not yet been built. The question remains which competencies leaders and
12
13 managers should focus on and prioritize in their occupational role as well as in praxis.
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16
17 Monika Ardel in her article "Wisdom as Expert Knowledge System: A Critical Review of a
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19 Contemporary Operationalization of Ancient Concept" gives an alternative model of wisdom,
20
21 which defines, operationalizes, and measures wisdom as the integration of cognitive, reflective, and
22
23 affective personality characteristics (Ardelt, 2004). These three different dimensions are defined
24
25 and operationalized as follows:
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27

28 The cognitive dimension consists of an understanding of life, the desire to know the truth,
29
30 deeper meanings of phenomena, particularly interpersonal and intrapersonal matters.
31
32 Operationalization assesses the ability and willingness to understand a situation or phenomena
33
34 thoroughly, knowledge of the positive and negative aspects of human nature, acknowledgment of
35
36 ambiguity and uncertainty in life, the ability to make important decisions despite life's
37
38 unpredictability and uncertainties
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42 The reflective dimension consists of the perception of phenomena and events from multiple
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44 perspectives, self-examination, self-awareness, and self-insight. Operationalization assesses the
45
46 ability to look at phenomena and events from different perspectives, the absence of subjectivity and
47
48 projections.
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51 The affective dimension consists of the sympathetic and compassionate love of others and
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53 the assessment should rate the presence of positive emotions and behavior toward others, and the
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55 absence of indifferent or negative emotions and behavior toward others.
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3 Based on the concepts above, Ardelt developed a three-dimensional wisdom scale (3D-WS)
4
5 to measure human wisdom as a standardized survey. The final version of the model assesses the
6
7 dimensions of wisdom using 14 items in the cognitive dimension, 12 items in the reflective
8
9 dimension, and 13 items in the affective dimension. Based on her wisdom studies with older people,
10
11 she proposed that “the simultaneous presence of a cognitive, reflective, and affective personality is
12
13 necessary but also sufficient for a person to be considered wise”. This means that, for business
14
15 people to be considered wise, at least these three dimensions should be activated in practical
16
17 management and leadership.
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21 Our methodology and methods to find out the traits of the phronetic leader start, however,
22
23 from the very beginning i.e., Space of Wisdom thinking. Practical, theoretical, technical, and
24
25 scientific dimensions and planes should be considered simultaneously to get an idea of the traits of
26
27 the phronetic leader. We understand that the descriptions of the traits come from each wisdom plane
28
29 as well as from the specifications of each knowledge and wisdom dimension. We have also used the
30
31 above articles to understand the main principles involved in these traits. Our target is to find a
32
33 general ontology of the phronetic leader. We operate first on a coarse level but we try to end up
34
35 with more specific traits by specifying their features. First, understanding the nature of the data and
36
37 information and then trying to understand the different knowledge contexts, types, organized
38
39 meanings, and knowledge-creating activities and characteristics creates possibilities for extensive
40
41 coverage of the traits of a phronetic leader. Phronetic knowledge creation and wisdom generation
42
43 thus show our base for constructing the ontology. See Table 1.
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51 Insert Table 1 about here.
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56 Human activities can be divided into two different categories, i.e. concrete activities and
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58 abstract activities. On the concrete side, we have data handling activities as well as information
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3 processing activities. On the abstract side, we have knowledge-creating activities and wisdom-
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5 generating activities. Each of the activities serves the higher level, i.e. from data activities we get
6
7 more information and from information activities we get more abstract knowledge through different
8
9 knowledge activities. All these activities serve in the end wisdom generation. On the other hand, we
10
11 can generate wisdom by demanding and absorbing more created knowledge. Wisdom-generating
12
13 activities have been divided according the dimensions in the Wisdom Cube, i.e. P = Phronesis,
14
15 S=Sophia, T = Techne and E = Episteme. All the 24 sentences are then used as features in the
16
17 Phronetic Leader Ontology.
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21
22 The Wisdom Cube provides the fundamental structure, dimensions, and planes for the
23
24 detailed specification of the knowledge and wisdom attributes. The content of the attributes is then
25
26 revealed so that the features can be described in more detail. All the above-presented articles have
27
28 widened our practical understanding enabling the creation of a final ontology for the phronetic
29
30 leader.
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33
34 We have also used our own previous research to obtain a holistic view of the mental-
35
36 physical structure of a human being. In our thinking, we come very near to the previously presented
37
38 thinking, because in our model too, the past accessible and realization of meanings in the human
39
40 mind: capability, experience, wisdom, both current and future targeted, are visible in the flow of
41
42 activities. We have developed a figure (see Figure 4), which describes the thinking behind our
43
44 ontology creation; we see the current stage of the ontology (object) and try to understand how it
45
46 may change in the future. The object here is the Phronetic Leader Ontology; the test subjects focus
47
48 on it and give their opinion and meaning about the statements they evaluate.
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53 Insert Figure 4 about here.
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3 In the figure above, it is possible to read how human productivity and latency develop in
4
5 time alongside human performance. The creation of explicit and tacit knowledge is important, but it
6
7 is vital to understand that knowledge always lies within humans and we develop ourselves inside of
8
9 our own wisdom space (cf. Ardel, 2004).
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12

13 14 **4. Ontology of the Phronetic Leader**

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16 The foundation of the ontology in this research is based on the Wisdom Cube presented in section
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18 2.5. We created an ontology that is used to describe the concepts related to phronetic leadership and
19
20 their relations. An ontology is a formal representation of a set of concepts within a domain and the
21
22 relationships between those concepts. Ontologies are essentially content theories because their main
23
24 contribution is to identify specific classes of objects, properties of objects, and relations that exist in
25
26 a specified domain (Chandrasekaran, Josephson & Benjamins, 1999). Ontologies provide potential
27
28 terms for describing knowledge about the domain (Chandrasekaran, Josephson & Benjamins,
29
30 1999). By their definition, ontologies are well suited to explicitly describing concepts that belong to
31
32 the organizational domain, in this case, leadership characteristics. The main components of an
33
34 ontology are classes (concepts), relations (associations between the concepts in the domain), and
35
36 instances (elements or individuals in the ontology) (Gómez-Pérez, 2004).
37
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41 The presented ontology is used to assess the characteristics of a phronetic leader. The basis
42
43 of the created ontology model and its statements lies in literature review discussing knowledge,
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45 wisdom and wise leadership characteristics (e.g. Bourantas, 2008; Kaipa & Radjou 2013, Nonaka,
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47 & Takeuchi, 2011).
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51 Table 2 describes the content of the ontology: how the concepts are grouped together to
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53 form the dimensions of wisdom. In addition to the evaluation of leadership characteristics, the
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55 created ontology can be used to study or teach the characteristics of a phronetic leader.
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60 Insert Table 2 about here.

The ontology consists of 161 statements grouped into 24 different concepts. The letter in parenthesis after the feature name (in figure 5) shows which dimension the feature belongs to as some of the features belong to more than one main dimension. The current version of the ontology assesses the dimensions of wisdom using 96 statements for Phronesis, 23 statements for Episteme, 36 statements for Sophia, and 29 statements for Techne. An average of 6.8 statements is used to describe each feature from different perspectives. For example, the feature Adding value is used to assess with statements such as “I plan how to develop our company in the changing business environment” and “The long term survival of our company depends on adding value to our customers and society”, and the feature Making sound judgments with statements like “I try to consider the best interests of all parties affected by my decisions” and “I try to look at situations from other people’s perspective”.

5. Technology and the Application Used

The application environment here is a specific leadership work-role environment according to the ontology of the phronetic leader. The evaluation process with the application starts by a self-assessment conducted by an employee, in this case, a manager or leader in an organization. The goal is to obtain an understanding of the individual’s own introspection of his/her phronetic leadership competencies. The self-assessment takes place through an examination of the leader’s/manager’s own thoughts, understanding, and feelings in his or her specific leadership work-role (See Figure 5). The individual performing the self-assessment can be seen as an autopoietic (self-defining) open system, i.e., a person who defines himself/herself at work in the surrounding organization in the specific work-role that s/he currently holds. In this leadership work-role, the individual can also evaluate objects in his or her situation according to the statements s/he is answering.

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3 The created phronetic leadership application, called Leda, operates on the architecture called
4 Evolute. Other co-evolutionary applications like Leda have been developed on the Evolute system.
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6 These have been used to assess different managerial concepts, such as, organizational commitment
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8 and engagement, organizational learning and knowledge creation, and safety culture.
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14 Insert Figure 5 about here.
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19 The Evolute methodology utilizes fuzzy logic (Zadeh, 1973) to capture the subjective,
20 abstract, and vague nature of an individual's current occupational competencies. The use of fuzzy
21 sets (Zadeh, 1965) allows the use of linguistic meanings directly without conversion to a numerical
22 scale. Fuzzy logic also facilitates approximate reasoning for analyzing and modeling different levels
23 of creative tension according to the occupational competencies and based on the individual's
24 perception of their current reality and vision (Senge, 1990), see Figure 6.
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33 The Evolute system precisiates the meaning on three different levels: 1) ontology
34 engineering, 2) fuzzy logic, and 3) collective perceptions. The term preciation is adopted from
35 professor Zadeh, the father of fuzzy logic, who coined the term in the contexts of CWW (computing
36 with words) and GTU (generalized theory of uncertainty) (Zadeh, 2005). In the Evolute self-
37 assessment applications, theoretical competencies are linked to practice through a comprehensive
38 set of statements, which people are asked to evaluate by giving their personal opinion of both their
39 personal (current) reality and personal vision, i.e., how things should be in the targeted state.
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49 In the Leda application, we follow the structure presented in the ontology above as well as
50 the statements attached to each concept. The Leda application is based on knowledge and wisdom
51 creation, especially in the leadership role. All the concepts inside the application are based on the
52 literature review and also the experience the authors have gained from similar application
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3 development work. The Evolute platform already contains several different work-role competence
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5 applications.
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10 Insert Figure 6 about here.
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14 All Evolute applications have been constructed and tested within the context of real-life
15 situations. Therefore, the platform, applications, methodology, and methods have been verified and
16 validated in practice. The Evolute system is based on web application frameworks and has multiple
17 components, which are illustrated in Figure 7.
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26 Insert Figure 7 about here.
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30 The Evolute process is the central part of the system, as illustrated. The user provides
31 several inputs to the system, which are processed and analyzed within the system, after which the
32 output is given to the user. Moreover, the same results are available on the researcher's Evolute
33 interface. The Evolute system includes a central database, which currently includes diverse and big
34 data from different objects and ontologies, which can be utilized in the analysis of different objects.
35 The Evolute fuzzy logic engine is utilized to calculate the user inputs to the system. Calculations are
36 made using the Evolute analytics engine, which generates an analysis of multiple inputs for users
37 and researchers. The data can be analyzed and reported several ways within the system.
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49 The Evolute web application is shown at the top of the triangle in Figure 7 and is utilized to
50 communicate with the end-users (e.g., receiving the inputs and viewing the report). The system
51 includes a RESTful API, which is utilized to integrate the Evolute system and its algorithms with
52 other systems like ERP and mobile applications. Moreover, the Evolute system provides an
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ontology editor, which makes it easy to create new or correct old ontologies in the system (see Figure 7).

6. Test Results with the Application

The first test runs have been completed with the application and it behaved according to the requirements. Verification tests have been made by the designers. The ontology can now describe the whole Wisdom Cube as well as the inner characteristics and traits of the phronetic leader. In Figure 8, the main dimensions: Episteme, Techne, Phronesis, and Sophia, describe the test subject's current state as well as the future aspirations to develop the degree of wisdom inside the test subject's own Wisdom Cube. The figure presents averages and standard deviations of the test group. The blue bars represent the current state results and their standard deviation, while the red bars represent the target-level results and their standard deviations. The lines represent the averages of the current and target state results. The application consists of 161 statements grouped into 24 different concepts. Answering the statements takes about 30 minutes. The analysis shows that all of the current states are close to each other, as are the future states.

Insert Figure 8 about here.

From Figure 8, we can conclude that there is variation in the answers. The results show clearly how each person viewed his own situation based on the presented statements. For a more detailed analysis covering the entire ontology, a more comprehensive review is needed. In Figure 9 below, all the concepts within the ontology are presented with the test subject's results. We can conclude that the subject has relatively many concepts that need to be improved or developed. The figure shows the Evolute Index, which describes the largest creative tensions between the target and the current states of the concepts.

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Insert Figure 9 about here.

From the results, we can see that the respondent wishes to develop phronetic leadership qualities in many ways. Creative tension, i.e., the relationship between the target and current state, seems to be the greatest in the concept of Integrating knowledge. This means that the subject has responded to the following statements with relatively low current values and relatively high target values: 1) I use stories, metaphors or figurative language when communicating with other people; 2) I try to communicate, even things that are difficult to understand, in a way that everybody can understand; 3) I try to speak with different people on different levels of the organization; 4) I use personal experiences and examples to get my message through; 5) I am good at influencing other people's thoughts and views; 6) I am able to be persuasive in my arguments; 7) I can communicate persuasively; 8) I can think logically and critically.

By analyzing more of these separate statements, the respondent can find ways to develop the concept of Integrating knowledge. In this example, there is a low creative tension in the concept of "Sensing right and wrong," meaning that the ethical virtue seems to be on a high level. In the same way, the subject can analyze the results and find a new path to improve the level of wisdom in his/her own Wisdom Cube.

7. Discussion and Conclusions

Individuals, companies, and societies are seeking ever more sensible decisions in local, regional, and global business, in which shared added-value creation is important and crucial. In the many-faceted business context of supply and demand, creating wisdom seems to be an extraordinarily demanding task. In the business world, challenges and opportunities vary and are manifold, but the ultimate goals and objectives should meet the supply and demand of shared added-value.

This style of leadership is characteristic of phronetic leaders. The knowledge they create, through knowledge-creating activities, is always incorporated into their wisdom. Phronetic leaders

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3 create and enhance their personal wisdom qualities and attributes in their own Space of Wisdom as
4 a process and/or as a state of being. New knowledge and wisdom are created from available
5 quantitative and qualitative business data and information. These leaders have special
6 characteristics, traits, and qualities that are closely related to situational management and
7 leadership. Depending on the business situation, they operationalize their knowledge and wisdom in
8 a personal way.

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17 In this research, the characteristics of the phronetic leader have been revealed through the
18 dimensions and planes of wisdom in the Wisdom Cube. Using the Wisdom Cube allows us to think
19 in a three-dimensional way, giving us opportunities to see the wisdom attributes needed for
20 phronetic leaders. The construct of the Wisdom Cube with the dimensions and planes of wisdom
21 has helped us to demonstrate the concepts of knowledge areas in Episteme (scientific), Sophia
22 (theoretical), Techne (technical), and Phronesis (practical). It has also given a strong base for
23 further analysis of what it means in the context of management and leadership.

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33 The occupational role ontology was revealed through the above-mentioned attributes with
34 concepts and indicators. This general construct has then been used in application development work
35 to create the Leda application, i.e., a phronetic leader application utilizing fuzzy logic. The target in
36 our research has been to find the position of leaders with characteristics of the phronetic leader in
37 the Wisdom Cube in addition to seeing how they are willing to improve these characteristics in the
38 future.

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47 The Wisdom Cube shows in a practical way how important it is to increase personal and
48 collective knowledge creation in organizations continuously. The Phronesis attributes focus on a
49 detailed deliberation about values from many directions. They also cover a large area of knowledge
50 creation to understand what to do now, how to do it, as well as looking into the future so that
51 decision-makers can support, lead, and decide the best possible paths for their own company.

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3 As for the scientific contribution (Episteme), we can conclude that the visualization of
4 wisdom helps to understand the creation of scientific knowledge. The attributes of scientific
5 knowledge clarify the requirements of “justified true belief”, which are clear demands for
6 knowledge creation in the management and leadership context. The theoretical contribution
7 (Sophia) in this research helps us to understand the attributes of theoretical knowledge. The
8 attribute “know why” focuses the reasoning process on answering why the management and
9 leadership constructs, concepts, and variables described in the ontology, produce important
10 information for knowledge and wisdom creation in specific business situations. The technical
11 dimension of wisdom and its relations to other wisdom dimensions can be seen as an enabler. Many
12 new scientific theories see the light of day through developed technologies. Techne transforms
13 scientific as well as theoretical discoveries and innovations for practical use. It can be said that
14 Techne converts human wisdom into practice. In this research, the technical contribution (Techne)
15 belongs mainly to the creation of the fuzzy logic-based application for the evaluation of the traits of
16 phronetic leaders. Regarding the practical contribution (Phronesis), we can mention the first test
17 cases in practice with the application, and the digital competence map of the phronetic leader traits.
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39 **8. Future Research**

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41 The Leda application has shown its potential to help managers and leaders improve their leadership
42 traits, but more research is needed to get feedback from them to better understand the application
43 performance. The created ontology also needs more critical thinking, evaluation, analysis, and
44 synthesis to find the best possible and easy-to-understand linguistic statements for the application.
45 Current research, therefore, requires practical validation from the perspective of leaders and
46 managers, as well as in-depth academic research. The vision, perception, interpretation, experience,
47 and understanding of the whole system and its concepts by leaders and managers are valuable not
48 only for developmental purposes but also for understanding whether such analysis is useful in their
49 professional role and work.
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3 We understand from the first tests that the utility, usability, and reliability of the application
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5 still need development. However, we can see that assessing the status of wisdom in the Wisdom
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7 Cube and understanding the personal degree of wisdom can already help leaders and managers to
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9 focus on improving the right dimensions, planes, and attributes in their current professional
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11 position. They can also experience, after the evaluation, how they have prioritized their leadership
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13 traits. In the future, when we have obtained more research data, it could be subjected to further
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15 analysis, for example, to try to find different clusters in the data, and to profile the people to distinct
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17 groups based on their characteristics. The used methodology could also be applied to specific work
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19 roles like project management and leadership, and project teaming, i.e. ideal team creation in
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21 different companies and organizations.
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26 The limitations of the study mainly concern the question of how respondents understand the
27
28 basic idea of the Wisdom Cube, the degree of wisdom, the main characteristics and traits of a
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30 phronetic leader, the connections to other basic dimensions, and the planes of wisdom. In addition,
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32 how the obtained information can be used for personal and organizational improvement.
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37 **9. Acknowledgments**

38 We would like to thank all the test subjects who participated in this research. We also thank the two
39
40 anonymous referees, who gave us valuable feedback to complete our manuscript to its final form.
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45 **10. Declaration of interests**

46 The authors declare that they have no known competing financial interests or personal relationships
47
48 that could have appeared to influence the work reported in this paper.
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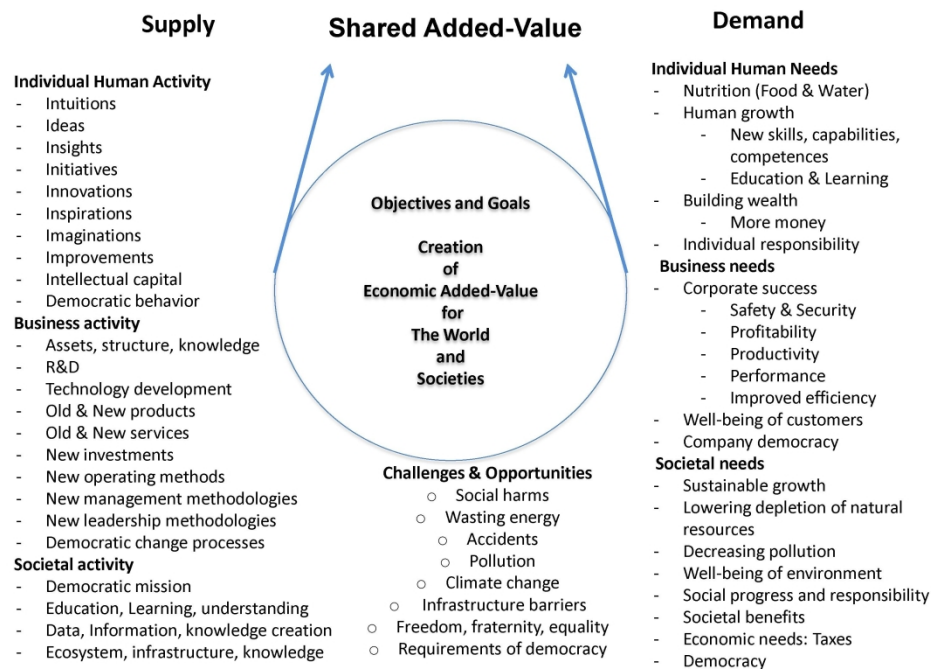


Figure 1. Supply and demand in the economic added-value context

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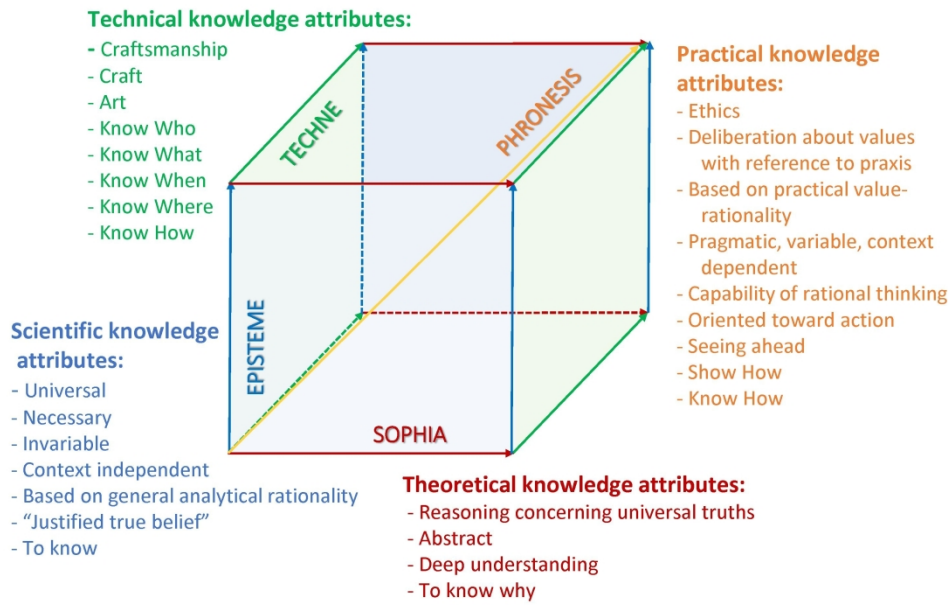


Figure 2. The Wisdom Cube with the Main Dimensions

260x170mm (300 x 300 DPI)

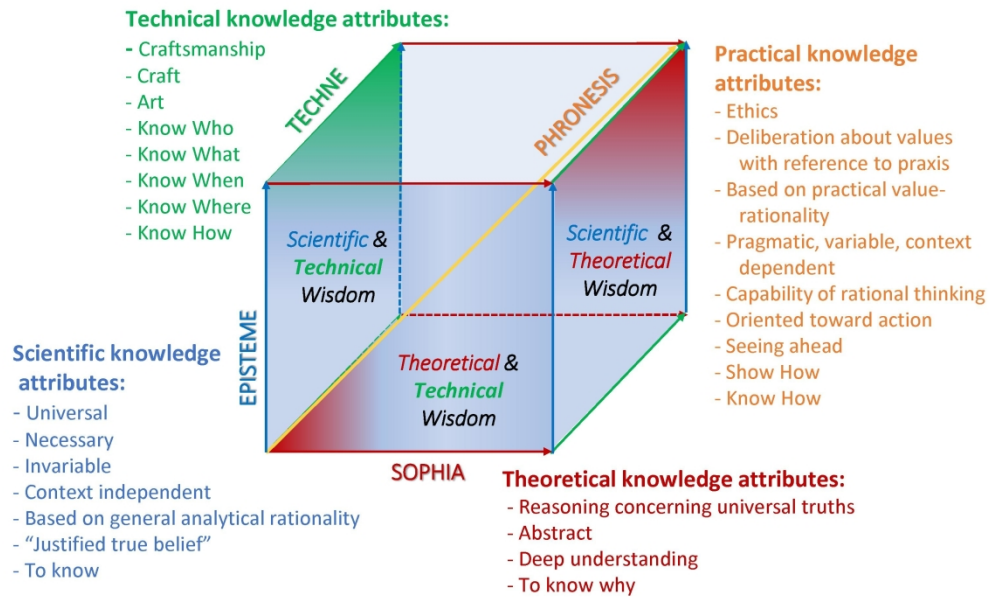


Figure 3. The Space of Wisdom with the dimensions and planes of wisdom

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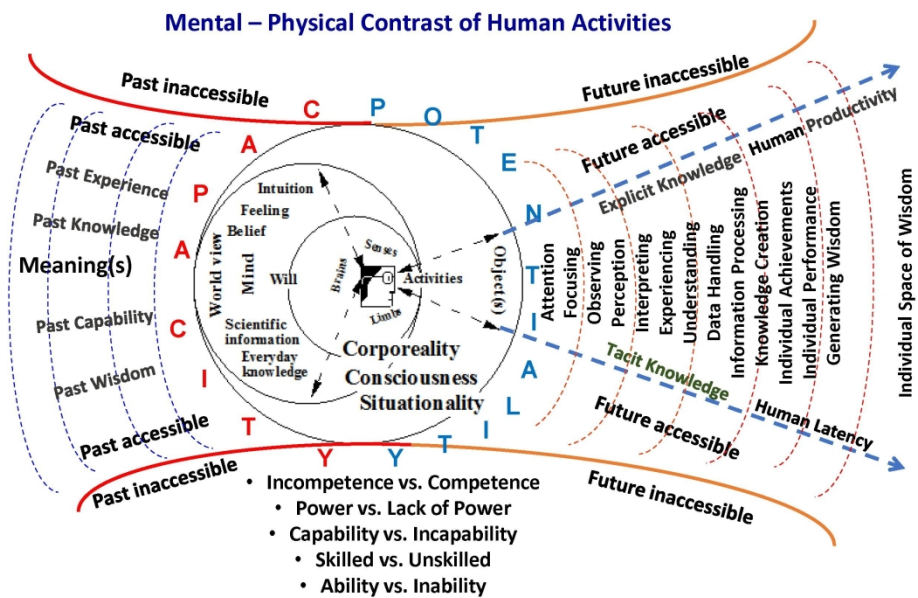


Figure 4. Mental-physical contrast on human activities and objects in the individual Wisdom Space

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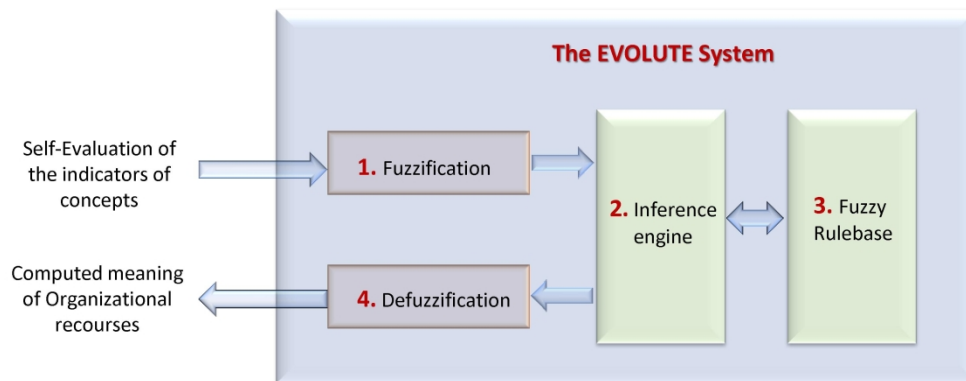


Figure 5. Interconnection between modules in the fuzzy application applied to the Evolute system

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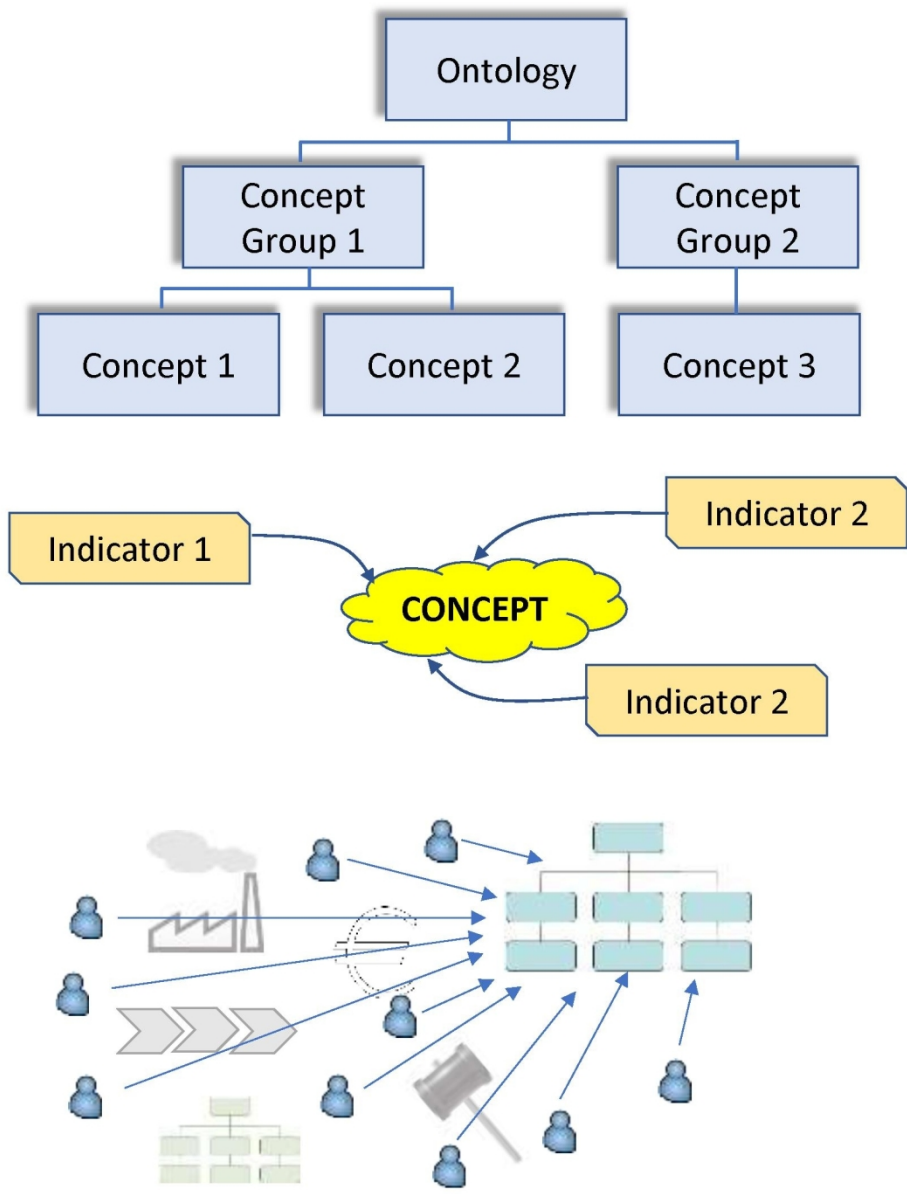


Figure 6. Meaning is precisiated on three levels of the Evolute system (example with company assets)

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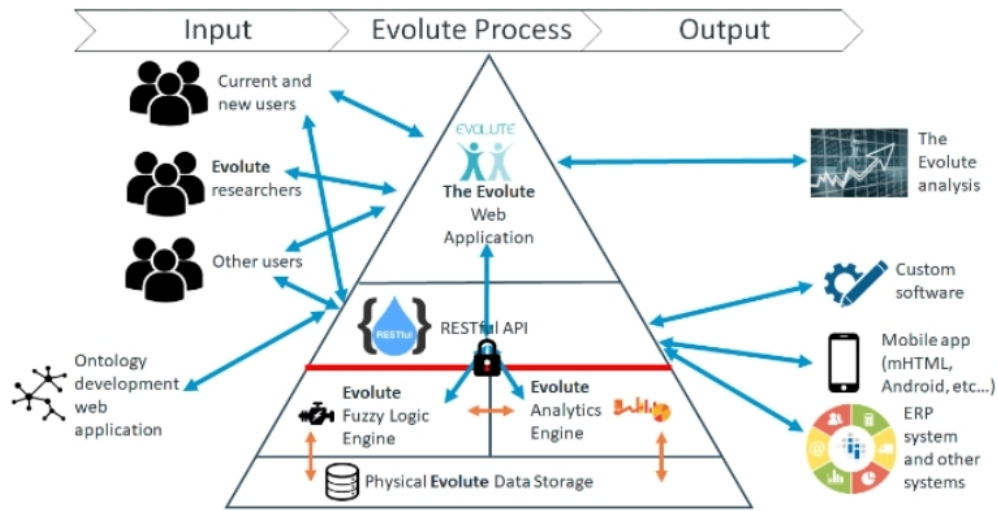


Figure 7. Evolute system framework

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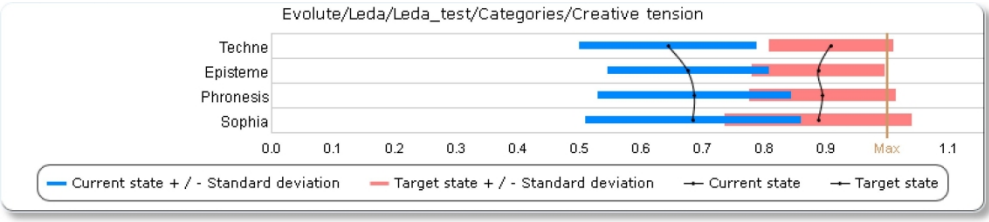


Figure 8. The results with the four main dimensions

285x63mm (300 x 300 DPI)

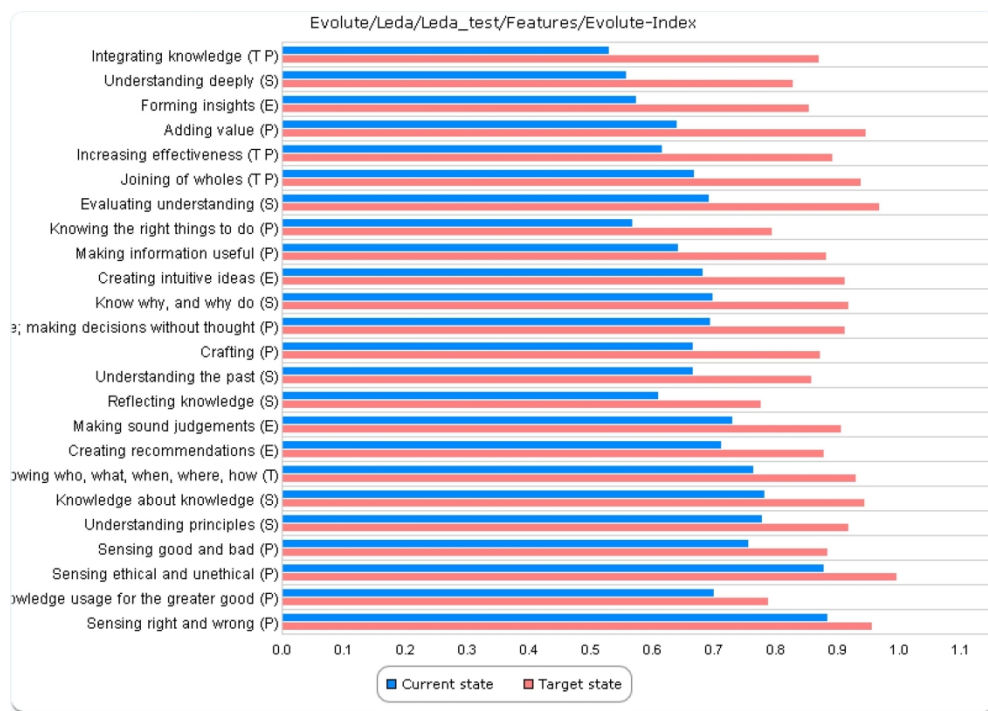


Figure 9. Detailed analysis of the concepts in the ontology

285x204mm (300 x 300 DPI)

Concrete ways		Human Activities		Abstract ways	
Data Handling Activities	Information Processing Activities	Knowledge Creating Activities	Wisdom Generating Activities		
1. Accumulating	1. Acquainting	1. Achieving objectives	23. Increasing human capacity, abilities, skills, competence, potentiality to use data & information	1. Adding value (P)	
2. Calculating	2. Answering	2. Analyzing	3. Applying	2. Crafting (P)	
3. Capturing	3. Aggregating	3. Applying	4. Contrasting	3. Creating intuitive ideas (E)	
4. Categorizing	4. Comparing	4. Contrasting	5. Comparing	4. Creating recommendations (E)	
5. Collating	5. Coding / Encoding	5. Comparing	6. Comprehending	5. Evaluating understanding (S)	
6. Collecting	6. Connecting	6. Comprehending	7. Creating	6. Forming insights (E)	
7. Communicating	7. Contextualizing	7. Creating	8. Deconstructing	7. Increasing effectiveness (T P)	
8. Displaying	8. Conversing	8. Deconstructing	9. Deliberating	8. Integrating knowledge (T P)	
9. Disseminating	9. Correlating	9. Deliberating	10. Describing	9. Joining of wholes (T P)	
10. Extracting	10. Eliminating	10. Describing	11. Evaluating	10. Knowledge about knowledge (S)	
11. Gathering	11. Filtering	11. Evaluating	12. Experiencing	11. Knowing the right things to do (P)	
12. Measuring	12. Forming	12. Experiencing	13. Explaining	12. Knowledge usage for the greater good (P)	
13. Observing	13. Framing	13. Explaining	14. Focusing	13. Knowing who, what, when, where, how (T)	
14. Protecting	14. Fusing	14. Focusing	15. Forming	14. Know why, and why do (S)	
15. Preparing	15. Ordering	15. Forming	16. Joining	15. Making information useful (P)	
12. Quantifying	16. Organizing	16. Joining	17. Imagining	16. Making sound judgements (E)	
13. Recording	17. Prioritizing	17. Imagining	18. Initiating	17. Reflecting knowledge (S)	
14. Reporting	18. Questioning	18. Initiating	19. Internalizing	18. Sensing ethical and unethical (P)	
15. Storing	19. Selecting	19. Internalizing	20. Interacting	19. Sensing good and bad (P)	
	20. Searching patterns	20. Interacting	21. Integrating	20. Sensing right and wrong (P)	
	21. Sharing	21. Integrating	22. Interpreting	21. Understanding deeply (S)	
	22. Transferring	22. Interpreting		22. Understanding the past (S)	
				23. Understanding principles (S)	
				24. Using tacit knowledge; making decisions without thought (P)	

Table 1. The base for the ontology construction

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2 **Dimension of Wisdom**

3 **Phronesis** Adding value (P)
4 Crafting (P)
5 Increasing effectiveness (T P)
6 Integrating knowledge (T P)
7 Joining of wholes (T P)
8 Knowing the right things to do (P)
9 Knowledge usage for the greater good (P)
10 Making information useful (P)
11 Sensing ethical and unethical (P)
12 Sensing good and bad (P)
13 Sensing right and wrong (P)
14 Using tacit knowledge; making decisions without thought (P)

18 **Episteme** Creating intuitive ideas (E)
19 Creating recommendations (E)
20 Forming insights (E)
21 Making sound judgements (E)

23 **Sophia** Evaluating understanding (S)
24 Knowledge about knowledge (S)
25 Know why, and why do (S)
26 Reflecting knowledge (S)
27 Understanding deeply (S)
28 Understanding the past (S)
29 Understanding principles (S)

32 **Techne** Increasing effectiveness (T P)
33 Integrating knowledge (T P)
34 Joining of wholes (T P)
35 Knowing who, what, when, where, how (T)