Phronetic Leadership Style Evaluation with a Fuzzy Logic Application

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Abstract

The aim of leadership style assessments is to reveal leaders' and managers' main activities and personality traits to determine the basic–features and characteristics of their leadership and management styles. The style can be, for example, democratic, autocratic, bureaucratic, laissez-faire, strategic, visionary, transformational, or transactional. However, ordinary assessments do not help leaders and managers analyze their own knowledge and the wisdom behind their behaviors in different business contexts and situations. The Wisdom Cube seeks to explain wisdom through the four dimensions of wisdom (i.e., Phronesis, Sophia, Episteme, and Techne) and provides a practical way of understanding knowledge and wisdom in management and leadership. By utilizing the dimensions and planes of the Wisdom Cube, we can find the way from data processing, information handling, and knowledge creation to the fundamentals of knowledge internalization and wisdom achievement. This deep understanding of leadership traits may be helpful in making current leadership styles more phronetic.

Key Words: Analysis, Leaders, Managers, Traits, Characteristics, Phronetic, Ontologies, Evaluation, Fuzzy Logic, Application

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 and it is also important to know the degree of knowledge and wise leadership traits. 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.
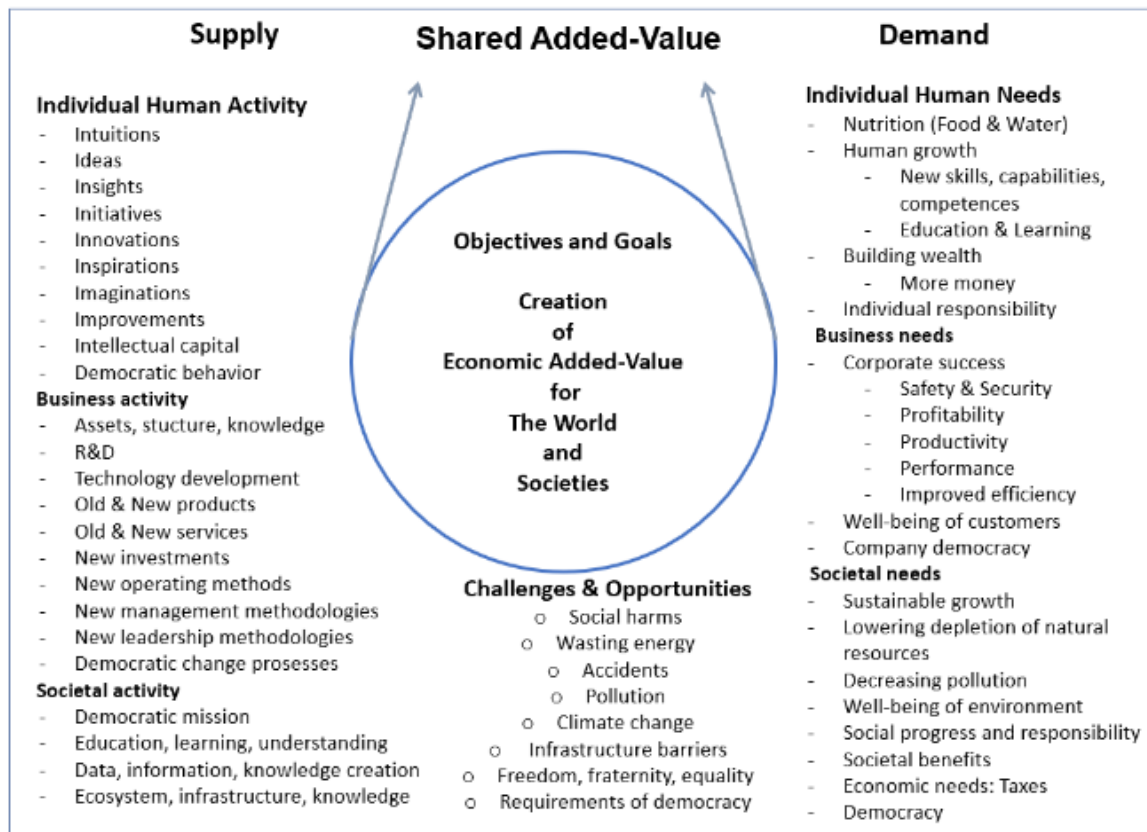
Figure 1. Supply and demand in the economic added-value context

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

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

In this research, we started to explore these upper echelon characteristics and traits on the basis of the thinking and writings of the ancient philosophers (Aristotle, 1999; Buckingham et al. 2011; Magee, 2016). We also used modern interpretations of the meanings of these texts (Ardelt, 2004; Baehr, 2014; Wittmer, 2013). This methodology gave us the chance to reveal the basic principles, constructs, and concepts of an ontology that we could convert into a fuzzy logic-based application for evaluating new leadership competencies, wise leadership traits, and styles. In the end, we used the Wisdom Cube framework for our application development work concerning the phronetic leadership style (Vanharanta & Markopoulos, 2019). 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.

The paper is divided into five main chapters as follows: Introduction, Dimensions of Knowledge and Wisdom, Traits of Phronetic Leader, Ontology of the Phronetic Leader, Technology and the Application Used, Test Results with the Application, Discussion, and Conclusions, as well as a short Future Research chapter.

2. Dimensions of Knowledge and Wisdom

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

2.1. Episteme

Episteme is an Ancient Greek word ἐπιστήμη *Epistêmê* most often translated as knowledge (Parry, 2014). It is based on the verb ἐπίστασθαι, meaning to know, to understand, to be acquainted with.

Aristotle has described more episteme in his Nicomachean Ethics (Aristotle, 1999):
"Scientific knowledge is about things that are universal and necessary, and the conclusions of demonstrations and all scientific knowledge follow from first principles (for scientific knowledge involves apprehension of the rational ground). This being so, the first principle from which what is

scientifically known follows cannot be an object of scientific knowledge, of art, or of practical wisdom; for that which can be scientifically known can be demonstrated, and art and practical wisdom deal with things that are variable."

In other words, what is scientifically known and true is invariable in time and space and can be demonstrated, and so things which are variable belong more to the areas of art, practical knowledge, and wisdom.

From the above, we can conclude in our context that taking Episteme, the scientific dimension of knowledge and wisdom, as a basis now demands a totally new type of teachable business knowledge regarding management and leadership. We have to show and demonstrate better and better the fundamentals so that we obtain more universal as well as necessary knowledge for management and leadership purposes. Although these are very demanding requirements in the social sciences, we believe that it is nevertheless natural and also practical to take the Episteme dimension, content, and direction into more profound consideration than before, especially if we use the other wisdom dimensions of Sophia, Techne, and Phronesis in business evaluations. Better scientific touch and understanding of Episteme will support and improve the other areas of knowledge and wisdom creation.

In the management and leadership context, Episteme is, therefore, an important basis for our thinking; however, we cannot follow principles which are valid in the natural sciences. We can only apply scientific knowledge in this context and suppose that in some things and issues we can reach an understanding level in our knowing that it is not even capable of being otherwise (cf. Aristotle, 1999). Therefore, the aspiration for scientific knowledge, Episteme, is also a necessity in the context of management and leadership. However, we understand that there are difficulties finding the knowledge that is context-independent, invariable, necessary, and universal. The scientific knowledge created in Episteme is based normally on general analytical rationality and the starting point is human intuition. The target is always to know and to create knowledge, i.e., "justified true belief", which will be then as close as possible to the demands of Episteme (cf. Aristotle, 1999; Vanharanta & Markopoulos, 2019).

2.2. Sophia

The Ancient Greek word *Sophia* (σοφία, *sophía*) is the abstract noun of σοφός (*sophós*), which has been variously described by the words skillful, able, intelligent, clever, cunning, prudent, wise, all of which characterize human traits. Sophia has also been described by Baeher in a wider context as the epistemic state concept, the cognitive faculty concept as well as intellectual trait concept (Baehr, 2014). Baeher also takes a wider perspective than Aristotle of the dimension of Sophia and calls it the theoretical dimension of wisdom (Baehr, 2014). He combines Episteme and Sophia by saying that the target in Sophia is "deep explanatory understanding of epistemically significant subject matter". This theoretical knowledge dimension has thus also been described as knowledge of "why" something is true. All this means that it is necessary for the human mind to find explanations to state why certain truths are true. A deep understanding is then necessary, which requires reasoning concerning universal truths. Abstract concepts make this reasoning difficult and often the results do not fulfill all the requirements in the business management and leadership context. The question "why" is therefore extremely important because it can open the way to a deep understanding of viable systems, abstract business constructs and concepts with many variables and indicators. Many cause-and-effect relationships and interrelationships are also difficult to observe without clever, skillful, intelligent, and wise managers and leaders. However, this is not enough because knowledge also needs clear background theories, methodologies, and methods, which help managers and leaders to make important connections with quantitative data and qualitative information for their knowledge creation and wisdom before any decision making.

2.3. Techne

A widespread definition of the meaning of Techne (Ancient Greek: tékʰnɛ) comes from Aristotle's texts. Aristotle saw it as "representative of the imperfection of human imitation of nature" (Aristotle, 1999). There are many examples that describe Techne as an activity that is concrete, variable, and context-dependent. Techne is both craft and art. Carpentry has been mentioned in Aristotle's texts as an example of Techne, as well as sciences like medicine and arithmetic. Often, Techne is thought of as more productive than theoretical, but Techne reveals its nature when people wish to obtain data and information concerning how to do something, i.e., technical knowledge and know-how. It is also interesting that it fulfills the requirement of Episteme that it can be taught. This, in turn, is related to the people who are behind this knowledge and wisdom. Techne has connections to people who can make, know what is needed, know when the need exists, and also the context where something is needed. Techne is therefore close not only to Phronesis, the practical dimension of wisdom but also to scientific Episteme and theoretical Sophia. Techne also has connections with communication, since people are connected to their cultures and communicate what they are going to do or make. Human skills, ability, capacity, capability, competence, commitment, and motivation show what a person is going to do and make. Techne aims at deeds, on a scale of duties and wants, where an activity or making something leads to an end or an end product (cf. von Wright, 1980). Techne is close to the terms: technique, technical, and technology, leading to production activities, i.e., inputs, processes, and outputs, as well as other mechanical or material components of real-world systems (cf. Aristotle, 1999; Vanharanta & Markopoulos, 2019).

2.4. Phronesis

Practical wisdom, Phronesis, is the fourth dimension of wisdom in the Wisdom Cube. It is an Ancient Greek word for a type of practical wisdom or intelligence (Ancient Greek: φρόνησῐς, *phrónēsis*). In his book, Nicomachean Ethics, Aristotle approaches Phronesis separately as one important area of wisdom (Aristotle, 1999). It describes dynamic and action-oriented knowledge and wisdom, but it also includes the capability as well as competence of rational thinking. Phronesis is based on practical value-rationality and the created knowledge is variable (not invariable) because it is very much a context- and situation-dependent dimension of knowledge and wisdom. Phronesis emphasizes deliberation about ethics and values with reference to practical needs. In business management and leadership, added and shared values constitute increased value, which the organization can produce for humankind with both its human intelligence and its fixed assets. One sub-dimension of Phronesis is looking ahead to or envisioning the future, i.e., the "power of foresight" (Aristotle, 1999), which is something which people trust to be important in their current situation. This wisdom often emerges when people know how to progress and also when they are capable of showing how to progress. Much of this wisdom and knowledge is connected to intuitive thinking in a specific context and situation and so we understand that Phronesis has connections to Episteme, Sophia, and Techne. Its pragmatic nature, common sense, serves people well and deliberation of ethics and values keeps it close to daily life. This dimension of wisdom is therefore very important in daily management and leadership when deep understanding and deliberation are needed (cf. Aristotle, 1999; Vanharanta & Markopoulos, 2019).

"Practical wisdom, on the other hand, is concerned with things human and things about which it is possible to deliberate; for we say this is above all the work of the man of practical wisdom, to deliberate well, but no one deliberates about things invariable, nor about things which have not an end, and that a good that can be brought about by action" (Aristotle, 1999).

2.5. The Wisdom Cube

The dimensions of wisdom can be visualized with the Wisdom Cube in the way that each of the dimensions briefly describes the main characteristics. See Figure 2.

Technical knowledge attributes:
- Craftsmanship
- Craft
- Art
- Know Who
- Know What
- Know When
- Know Where
- Know How

TECHNE

PHRONESIS

EPISTEME

SOPHIA

Practical knowledge attributes:
- Ethics
- Deliberation about values with reference to praxis
- Based on practical value-rationality
- Pragmatic, variable, context dependent
- Capability of rational thinking
- Oriented toward action
- Seeing ahead
- Show How
- Know How

Scientific knowledge attributes:
- Universal
- Necessary
- Invariable
- Context independent
- Based on general analytical rationality
- "Justified true belief"
- To know

Theoretical knowledge attributes:
- Reasoning concerning universal truths
- Abstract
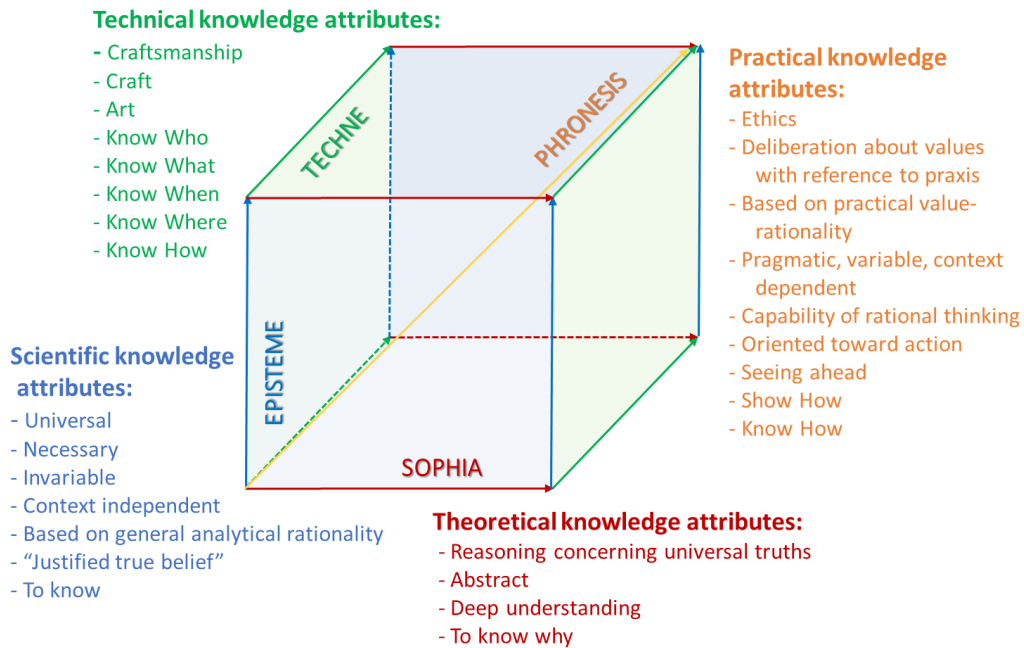- Deep understanding
- To know why

Figure 2. The Wisdom Cube with the Main Dimensions (Vanharanta & Markopoulos, 2019)

From the Wisdom Cube, we can discover the planes which cover the contents of each dimension belonging to the plane. See Figure 3.

Technical knowledge attributes:
- Craftsmanship
- Craft
- Art
- Know Who
- Know What
- Know When
- Know Where
- Know How

TECHNE

PHRONESIS

EPISTEME

SOPHIA

Scientific & **Technical** *Wisdom*

Scientific & **Theoretical** *Wisdom*

Theoretical & **Technical** *Wisdom*

Practical knowledge attributes:
- Ethics
- Deliberation about values with reference to praxis
- Based on practical value-rationality
- Pragmatic, variable, context dependent
- Capability of rational thinking
- Oriented toward action
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- Show How
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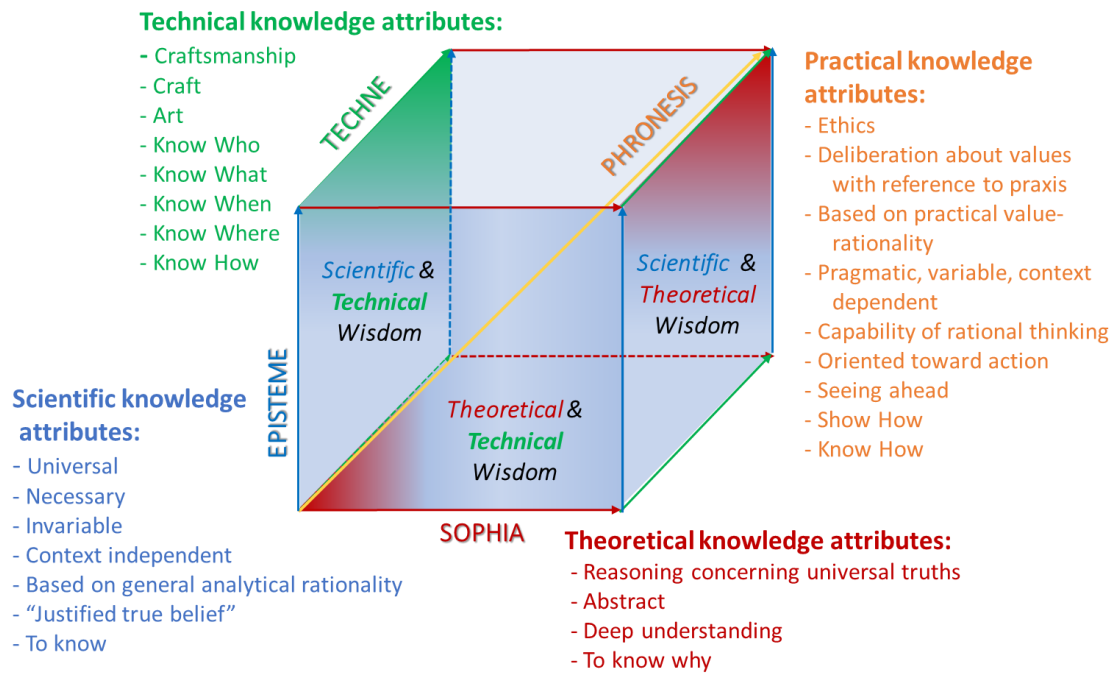- Abstract
- Deep understanding
- To know why

Figure 3. The Space of Wisdom with the dimensions and planes of wisdom (Vanharanta & Markopoulos, 2019)

Figure 3 very clearly shows that breaking down the construct into different characteristics helps us understand the nature of wisdom and it also shows how important it is to use this created knowledge for teaching purposes as well as for development purposes in the management and leadership context. Figure 3 allows us to go further and penetrate deeper into the secrets of business knowledge in the specific context we have taken. Humans behave as active members inside this Space of Wisdom, as entities, i.e., as living systems (Miller, 1978).

The Planes and Space of Wisdom show that the Ancient Philosophers reached a deep level of understanding that gives us great opportunities now to see ourselves as members and owners of that 'big knowledge and wisdom'. The degree of wisdom in each plane can describe an individual's position in the overall universal Space of Wisdom. A strong scientific, theoretical, and technical understanding and education throughout the Planes of Wisdom make important paths for managers and leaders to attain a strong position in their organization. They should place and position themselves with the current understanding and then use their creative tension to move from that position to a future position (cf. Senge, 1990).

3. Traits of the Phronetic Leader

Phronetic leadership has long been a paradigm for wise practical leadership and there have been many different ideas and models on how to develop the traits of leaders and managers to reach the level of wise leadership.

Following the origin of practical wisdom by Aristotle, Ikujiro Nonaka and Hirotaka Takeuchi have described phronetic leaders with six different abilities (abilities to lead wisely) (Nonaka & Takeuchi, 2011): 1) Wise leaders can judge goodness, which means that leaders exercise moral sensitivity, target the common good, and see the company as being in harmony with the society; 2) Wise leaders can grasp the essence, which means that leaders understand the current business situation and actions needed. They sense the essential and clarify the nature and meaning of people, things, and events intuitively. From the Episteme dimension, they should also grasp the universal truths from the important particulars and details, as Aristotle teaches us; 3) Wise leaders create shared contexts, which means that the leaders create learning environments for employees in which relationships are strengthened and interactions initiated; 4) Wise leaders communicate the essence, which means that leaders communicate in an understandable way and give the big picture of the business to the members of their organization. They also use storytelling and metaphors effectively. They have the ability to grasp relationships and interrelationships between one thing and another. They understand well the past, present, and visions of the future. They naturally come down to the shop floor and communicate easily with company employees. They show clearly that they are committed and engaged with the personnel and the company; 5) Wise leaders exercise political power, which means uniting people to take action using all the means suited to the situation and understanding human nature both bad and good, optimism and pessimism, civility and incivility, diligence and laziness. Wise leaders master dialectical thinking, which gives them possibilities to deal with dichotomies, contradictions, opposites, and paradoxes. Using imagination, insights, and envisioning they can reach higher conceptual levels; 6) Wise leaders foster practical wisdom in others, which means that leaders facilitate the distribution of practical wisdom as much as possible in the organization and teach members to use wisdom. Companies can then respond flexibly and creatively to any situation and change.

In his article "World Awaits Phronetic Business Leaders", Manu Melwin Joy, following the six quality models of Nonaka and Takeuchi, has also presented role models of persons who have or have

had the above-mentioned leadership traits like Soichiro Honda, Ratan Tata, Martin Luther King, Steve Jobs, F. Scott Fitzgerald (cf. Joy, 2017).

Thomas Shinto (Shinto, 2017) has also used the Aristotelian concept of practical wisdom (Phronesis) in his attempt to show how important it is that phronetic attributes are taken into account to support the professional excellence of modern managers. His Phronetic Professional Excellence model (PPE), based on an ancient and modern interpretation of Phronesis, has been constructed with five different characteristics:

1) Base > Phronesis operates on the basis of values and virtues
2) Formation > Phronesis is a dynamic interplay of conjoint enablers like Praxis, Personality, Cognition, Perception, and Deliberation
3) Action > Phronesis is action-oriented and holds the manager accountable for the best management of men, resources, and operations
4) Result > Phronesis is result-oriented to achieve the optimum results in organizational, operational, and individual realms
5) Vision > Phronesis is vision-oriented with insights into what is of ultimate and proximate good for all.

According Thomas, the main system boundary of his PPE model consists of Phronesis, Culture, and Environment. The operational part with praxis, personality, cognition, perception, and deliberation lies around the core of value and virtue. The operational part covers all the accountable issues in management and leadership culminating ultimately in the results of management and leadership in terms of organizational, operational, as well as individual results. The ultimate goal is to reach lasting "goodness".

Thomas expands the content of the abilities presented by Nonaka and Takeuchi with competence thinking. The essential abilities required for being a phronetic leader, according to Thomas, contain the following competencies:

1) Conceptual competence > Mindfulness, use of concepts, Systems thinking, Pattern recognition, and Tacit knowledge
2) Emotional competence > Intrapersonal intelligence, Interpersonal intelligence
3) Technical competence > Technical proficiency, Knowledge sharing & networks, Information management, Continuous learning and development, Coaching
4) Ontological competence > Ability to see the meaning of existence beyond concrete reality, Happiness, Love of wisdom, Freedom, Passion, Good of all, Harmony between the individual good and universal good, Metacognitive intelligence, and Existential intelligence.

Thomas's PPE model supports Nonaka and Takeuchi's thinking about abilities very well and puts everything inside a dynamic and visual model which aids overall understanding. However, the measurement of these abilities, characteristics, and competences has not been revealed by any means and the final structure of human capacity, potentiality, skills, abilities, capabilities, and competencies have not yet been built. The question remains which competencies leaders and managers should focus on and prioritize in their occupational role as well as in praxis.

Monika Ardelt in her article "Wisdom as Expert Knowledge System: A Critical Review of a Contemporary Operationalization of Ancient Concept" gives an alternative model of wisdom, which defines, operationalizes, and measures wisdom as the integration of cognitive, reflective, and

affective personality characteristics (Ardelt, 2004). These three different dimensions are defined and operationalized as follows:

1) The cognitive dimension consists of an understanding of life, the desire to know the truth, deeper meanings of phenomena, particularly interpersonal and intrapersonal matters. Operationalization assesses the ability and willingness to understand a situation or phenomena thoroughly, knowledge of the positive and negative aspects of human nature, acknowledgment of ambiguity and uncertainty in life, the ability to make important decisions despite life's unpredictability and uncertainties

2) The reflective dimension consists of the perception of phenomena and events from multiple perspectives, self-examination, self-awareness, and self-insight. Operationalization assesses the ability to look at phenomena and events from different perspectives, the absence of subjectivity and projections.

3) The affective dimension consists of the sympathetic and compassionate love of others and the assessment should rate the presence of positive emotions and behavior toward others, and the absence of indifferent or negative emotions and behavior toward others.

Based on the concepts above, Ardelt developed a three-dimensional wisdom scale (3D-WS) to measure human wisdom as a standardized survey. The final version of the model assesses the dimensions of wisdom using 14 items in the cognitive dimension, 12 items in the reflective dimension, and 13 items in the affective dimension. Based on her wisdom studies with older people, she proposed that "the simultaneous presence of a cognitive, reflective, and affective personality is necessary but also sufficient for a person to be considered wise". This means that, for business people to be considered wise, at least these three dimensions should be activated in practical management and leadership.

Our methodology and methods to find out the traits of the phronetic leader start, however, from the very beginning i.e., Space of Wisdom thinking. Practical, theoretical, technical, and scientific dimensions and planes should be considered simultaneously to get an idea of the traits of the phronetic leader. We understand that the descriptions of the traits come from each wisdom plane as well as from the specifications of each knowledge and wisdom dimension. We have also used the above articles to understand the main principles involved in these traits. Our target is to find a general ontology of the phronetic leader. We operate first on a coarse level but we try to end up with more specific traits by specifying their features. First, understanding the nature of the data and information and then trying to understand the different knowledge contexts, types, organized meanings, and knowledge-creating activities and characteristics creates possibilities for extensive coverage of the traits of a phronetic leader. Phronetic knowledge creation and wisdom generation thus show our base for constructing the ontology. See Table 1.

Table 1. The base for the ontology construction

Concrete ways		Human Activities		Abstract ways
Data Handling Activities	**Information Processing Activities**	**Knowledge Creating Activities**		**Wisdom Generating Activities**
1. Accumulating 2. Calculating 3. Capturing 4. Categorizing 5. Collating 6. Collecting 7. Communicating 8. Displaying 9. Disseminating 10. Extracting 11. Gathering 12. Measuring 13. Observing 14. Protecting 15. Preparing 12. Quantifying 13. Recording 14. Reporting 15. Storing	1. Acquainting 2. Answering 3. Aggregating 4. Comparing 5. Coding / Encoding 6. Connecting 7. Contextualizing 8. Conversing 9. Correlating 10. Eliminating 11. Filtering 12. Forming 13. Framing 14. Fusing 15. Ordering 16. Organizing 17. Prioritizing 18. Questioning 19. Selecting 20. Searching patterns 21. Sharing 22. Transferring	1. Achieving objectives 2. Analyzing 3. Applying 4. Contrasting 5. Comparing 6. Comprehending 7. Creating 8. Deconstructing 9. Deliberating 10. Describing 11. Evaluating 12. Experiencing 13. Explaining 14. Focusing 15. Forming 16. Joining 17. Imagining 18. Initiating 19. Internalizing 20. Interacting 21. Integrating 22. Interpreting	23. Increasing human capacity, abilities, skills, competence, potentiality to use data & information 24. Justifying true beliefs 25. Knowing 26. Listening / Interviewing 27. Perceiving 28. Reasoning 29. Reflecting 30. Remembering 31. Seeing ahead 32. Showing how 33. Simulating 34. Storytelling / narrating 35. Structuring 36. Synthesizing 37. Thinking rationally & habits 38. Thoughts in individuals mind: inner speech 39. Timing 40. Understanding objectives, patterns, relations, interrelations	1. Adding value (P) 2. Crafting (P) 3. Creating intuitive ideas (E) 4. Creating recommendations (E) 5. Evaluating understanding (S) 6. Forming insights (E) 7. Increasing effectiveness (T P) 8. Integrating knowledge (T P) 9. Joining of wholes (T P) 10. Knowledge about knowledge (S) 11. Knowing the right things to do (P) 12. Knowledge usage for the greater good (P) 13. Knowing who, what, when, where, how (T) 14. Know why, and why do (S) 15. Making information useful (P) 16. Making sound judgements (E) 17. Reflecting knowledge (S) 18. Sensing ethical and unethical (P) 19. Sensing good and bad (P) 20. Sensing right and wrong (P) 21. Understanding deeply (S) 22. Understanding the past (S) 23. Understanding principles (S) 24. Using tacit knowledge; making decisions without thought (P)

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Human activities can be divided into two different categories, i.e. concrete activities and abstract activities. On the concrete side, we have data handling activities as well as information processing activities. On the abstract side, we have knowledge-creating activities and wisdom-generating activities. Each of the activities serves the higher level, i.e. from data activities we get more information and from information activities we get more abstract knowledge through different knowledge activities. All these activities serve in the end wisdom generation. On the other hand, we can generate wisdom by demanding and absorbing more created knowledge. Wisdom-generating activities have been divided according the dimensions in the Wisdom Cube, i.e. P = Phronesis, S=Sophia, T = Techne and E = Episteme. All the 24 sentences are then used as features in the Phronetic Leader Ontology.

The Wisdom Cube provides the fundamental structure, dimensions, and planes for the detailed specification of the knowledge and wisdom attributes. The content of the attributes is then revealed so that the features can be described in more detail. All the above-presented articles have widened our practical understanding enabling the creation of a final ontology for the phronetic leader.

We have also used our own previous research to obtain a holistic view of the mental-physical structure of a human being. In our thinking, we come very near to the previously presented thinking, because in our model too, the past accessible and realization of meanings in the human mind: capability, experience, wisdom, both current and future targeted, are visible in the flow of activities. We have developed a figure (see Figure 4), which describes the thinking behind our ontology creation; we see the current stage of the ontology (object) and try to understand how it may change in the future. The object here is the Phronetic Leader Ontology; the test subjects focus on it and give their opinion and meaning about the statements they evaluate.
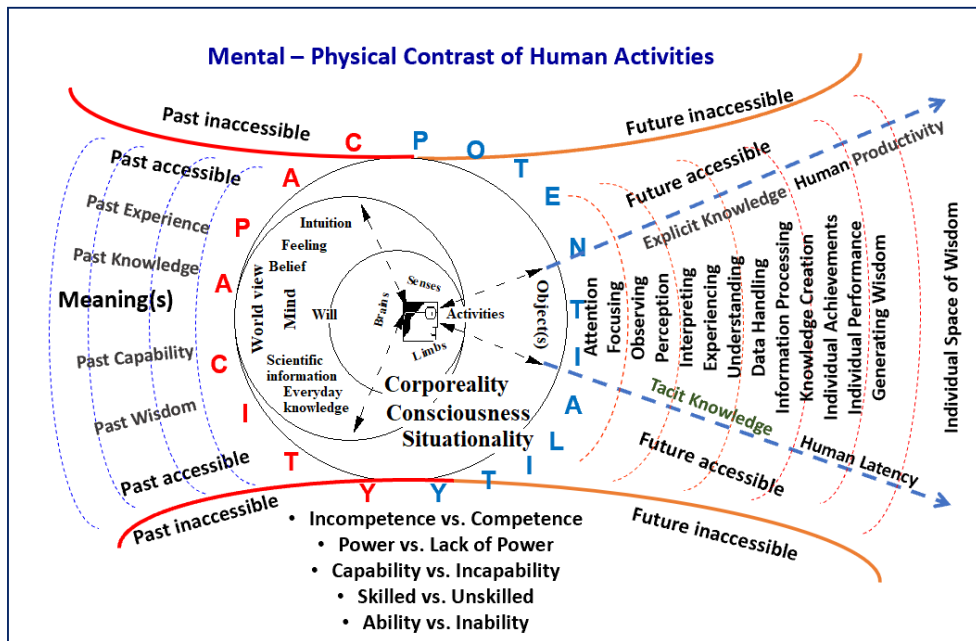
Figure 4. Mental-physical contrast on human activities and objects in the individual Wisdom Space

In the figure above, it is possible to read how human productivity and latency develop in time alongside human performance. The creation of explicit and tacit knowledge is important, but it is vital to understand that knowledge always lies within humans and we develop ourselves inside of our own wisdom space (cf. Ardelt, 2004).

4. Ontology of the Phronetic Leader

The foundation of the ontology in this research is based on the Wisdom Cube presented in section 2.5. We created an ontology that is used to describe the concepts related to phronetic leadership and their relations. An ontology is a formal representation of a set of concepts within a domain and the relationships between those concepts. Ontologies are essentially content theories because their main contribution is to identify specific classes of objects, properties of objects, and relations that exist in a specified domain (Chandrasekaran, Josephson & Benjamins, 1999). Ontologies provide potential terms for describing knowledge about the domain (Chandrasekaran, Josephson & Benjamins, 1999). By their definition, ontologies are well suited to explicitly describing concepts that belong to the organizational domain, in this case, leadership characteristics. The main components of an ontology are classes (concepts), relations (associations between the concepts in the domain), and instances (elements or individuals in the ontology) (Gómez-Pérez, 2004).

The presented ontology is used to assess the characteristics of a phronetic leader. The basis of the created ontology model and its statements lies in literature review discussing knowledge, wisdom and wise leadership characteristics (e.g. Bourantas, 2008; Kaipa & Radjou 2013, Nonaka, & Takeuchi, 2011).

Figure 5 describes the content of the ontology: how the concepts are grouped together to form the dimensions of wisdom. In addition to the evaluation of leadership characteristics, the created ontology can be used to study or teach the characteristics of a phronetic leader.

Dimension of Wisdom	
Phronesis	Adding value (P)
	Crafting (P)
	Increasing effectiveness (T P)
	Integrating knowledge (T P)
	Joining of wholes (T P)
	Knowing the right things to do (P)
	Knowledge usage for the greater good (P)
	Making information useful (P)
	Sensing ethical and unethical (P)
	Sensing good and bad (P)
	Sensing right and wrong (P)
	Using tacit knowledge; making decisions without thought (P)
Episteme	Creating intuitive ideas (E)
	Creating recommendations (E)
	Forming insights (E)
	Making sound judgements (E)
Sophia	Evaluating understanding (S)
	Knowledge about knowledge (S)
	Know why, and why do (S)
	Reflecting knowledge (S)
	Understanding deeply (S)
	Understanding the past (S)
	Understanding principles (S)
Techne	Increasing effectiveness (T P)
	Integrating knowledge (T P)
	Joining of wholes (T P)
	Knowing who, what, when, where, how (T)

Figure 5. Dimensions of Wisdom in the research ontology

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 develope 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 6). 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.

The created phronetic leadership application, called Leda, operates on the architecture called Evolute (Kantola, Vanharanta & Karwowski, 2006). Other co-evolutionary applications like Leda have been developed on the Evolute system (Kantola, 2015). These have been used to assess different managerial concepts, such as, organizational commitment and engagement (Einolander, 2018), organizational learning and knowledge creation (Paajanen, 2012), and safety culture (Piirto, 2012). For more information how the ontologies were developed please see (e.g. Kantola, 2015, Einolander, 2018).
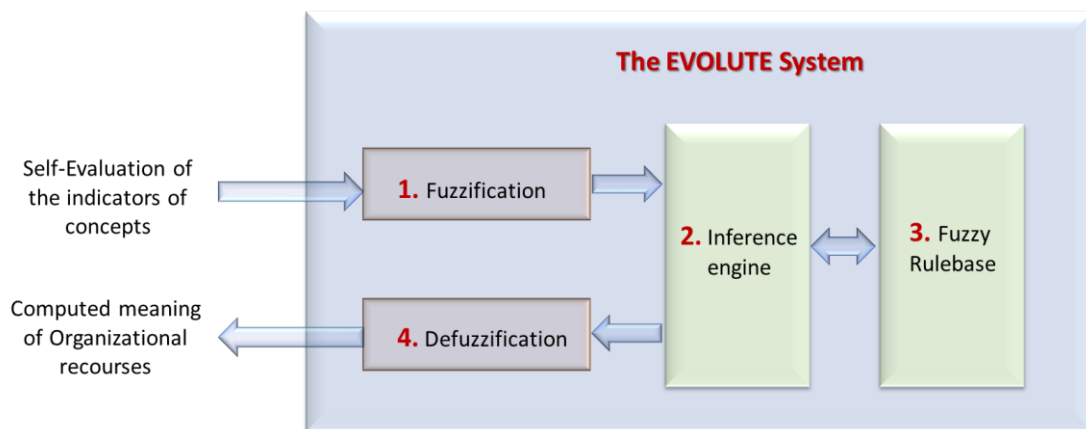

Figure 6. Interconnection between modules in the fuzzy application applied to the Evolute system (Kantola, 2006)

The Evolute methodology utilizes fuzzy logic (Zadeh, 1973) to capture the subjective, abstract, and vague nature of an individual's current occupational competencies. The use of fuzzy sets (Zadeh, 1965) allows the use of linguistic meanings directly without conversion to a numerical scale. Fuzzy logic also facilitates approximate reasoning for analyzing and modeling different levels of creative tension according to the occupational competencies and based on the individual's perception of their current reality and vision (Senge, 1990), see Figure 7.

The Evolute system precisiates the meaning on three different levels: 1) ontology engineering, 2) fuzzy logic, and 3) collective perceptions. The term preciciation is adopted from professor Zadeh, the father of fuzzy logic, who coined the term in the contexts of CWW (computing with words) and GTU (generalized theory of uncertainty) (Zadeh, 2005). In the Evolute self-assessment applications, theoretical competencies are linked to practice through a comprehensive set of statements, which people are asked to evaluate by giving their personal opinion of both their personal (current) reality and personal vision, i.e., how things should be in the targeted state.

In the Leda application, we follow the structure presented in the ontology above as well as the statements attached to each concept. The Leda application is based on knowledge and wisdom creation, especially in the leadership role. All the concepts inside the application are based on the literature review and also the experience the authors have gained from similar application development work. The Evolute platform already contains several different work-role competence applications.
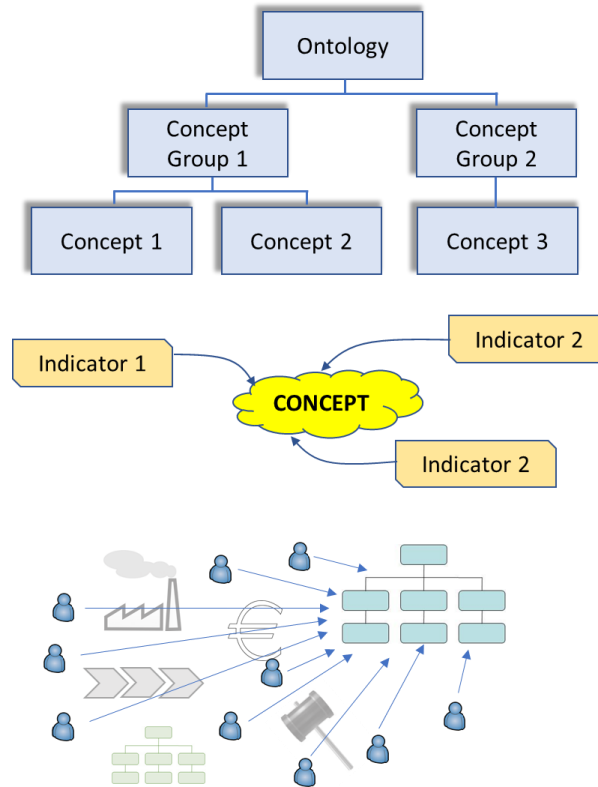

Figure 7. Meaning is precisiated on three levels of the Evolute system (example with company assets) (Kantola, 2015)

All Evolute applications have been constructed and tested within the context of real-life situations. Therefore, the platform, applications, methodology, and methods have been verified and validated in practice. The Evolute system is based on web application frameworks and has multiple components, which are illustrated in Figure 8.
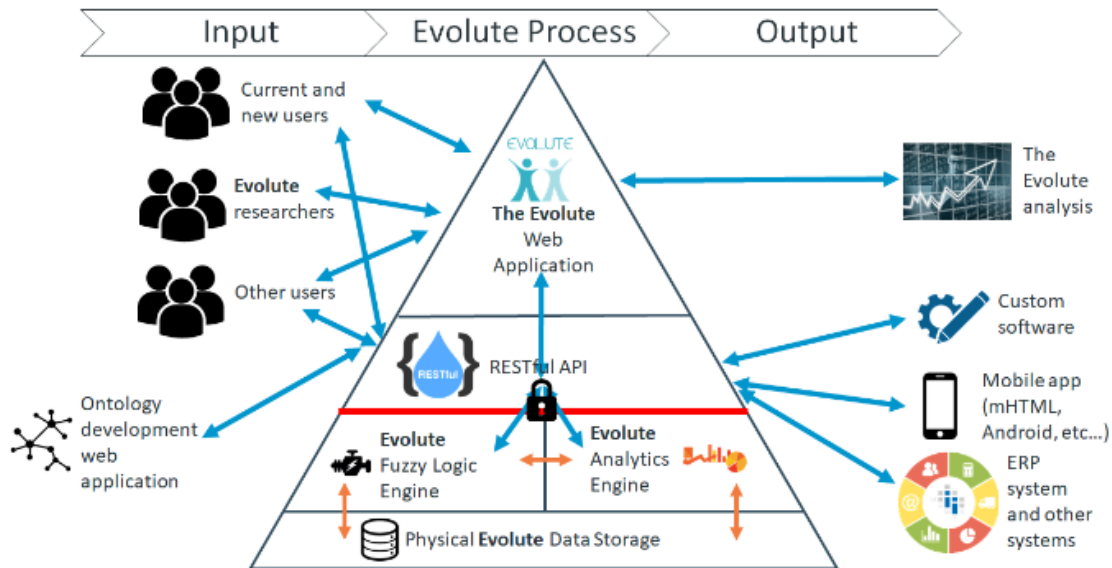
Figure 8. Evolute system framework

The Evolute process is the central part of the system, as illustrated. The user provides several inputs to the system, which are processed and analyzed within the system, after which the output is given to the user. Moreover, the same results are available on the researcher's Evolute interface. The Evolute system includes a central database, which currently includes diverse and big data from different objects and ontologies, which can be utilized in the analysis of different objects. The Evolute fuzzy logic engine is utilized to calculate the user inputs to the system. Calculations are made using the Evolute analytics engine, which generates an analysis of multiple inputs for users and researchers. The data can be analyzed and reported several ways within the system.

The Evolute web application is shown at the top of the triangle in Figure 8 and is utilized to communicate with the end-users (e.g., receiving the inputs and viewing the report). The system includes a RESTful API, which is utilized to integrate the Evolute system and its algorithms with other systems like ERP and mobile applications. Moreover, the Evolute system provides an ontology editor, which makes it easy to create new or correct old ontologies in the system (see Figure 8).

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 9, 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.
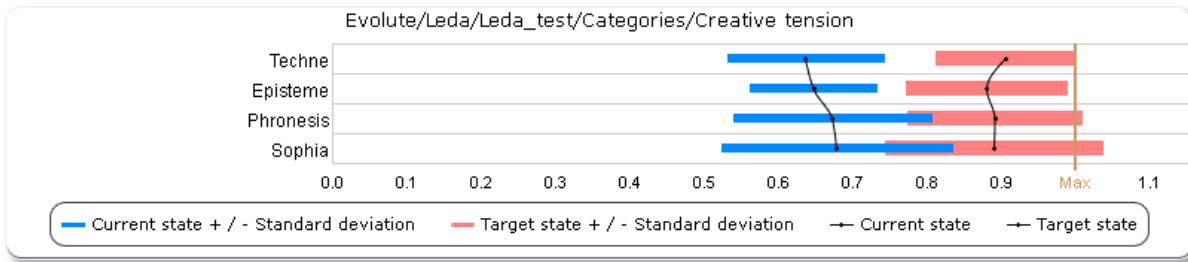
Figure 9. The results with the four main dimensions

From Figure 9, 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 10 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.
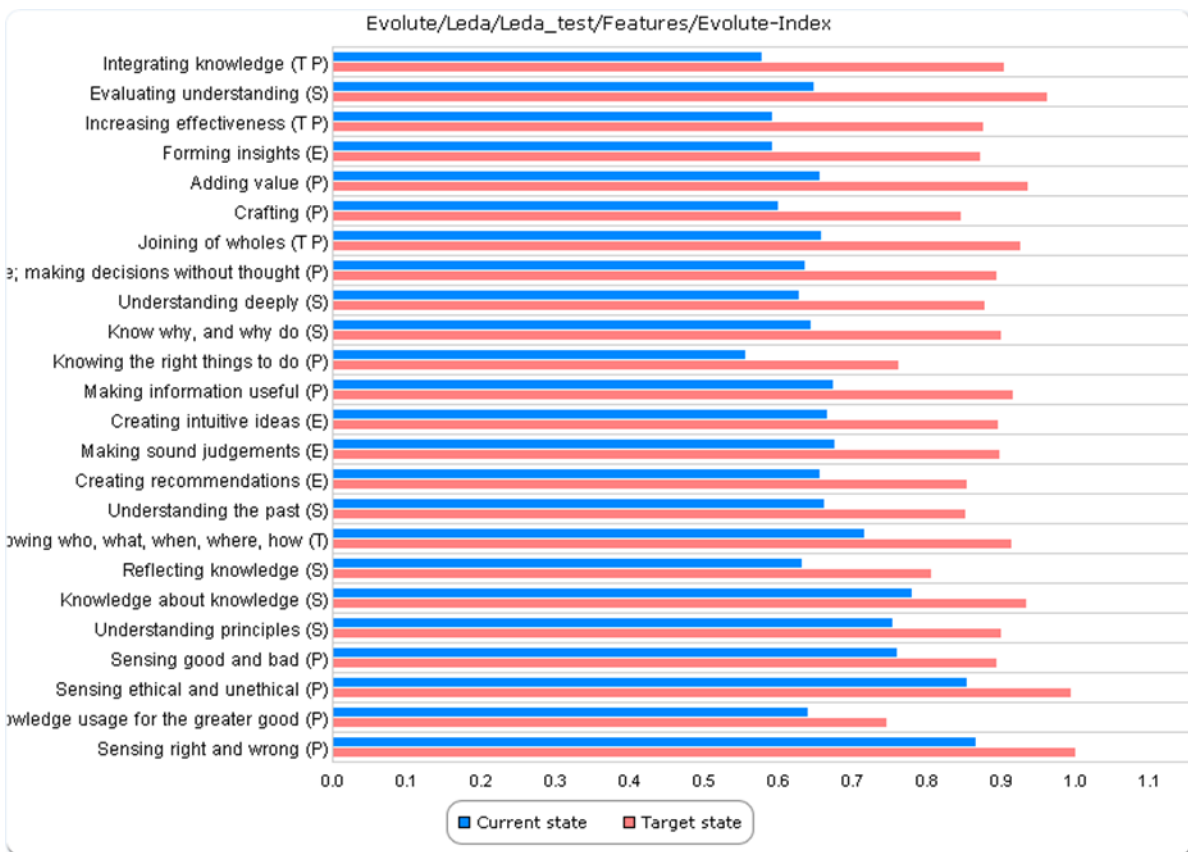

Figure 10. Detailed analysis of the concepts in the ontology

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

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

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

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

As for the scientific contribution (Episteme), we can conclude that the visualization of wisdom helps to understand the creation of scientific knowledge. The attributes of scientific knowledge clarify

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

8. Future Research

The Leda application has shown its potential to help managers and leaders improve their leadership traits, but more research is needed to get feedback from them to better understand the application performance. The created ontology also needs more critical thinking, evaluation, analysis, and synthesis to find the best possible and easy-to-understand linguistic statements for the application. Current research, therefore, requires practical validation from the perspective of leaders and managers, as well as in-depth academic research. The vision, perception, interpretation, experience, and understanding of the whole system and its concepts by leaders and managers are valuable not only for developmental purposes but also for understanding whether such analysis is useful in their professional role and work.

We understand from the first tests that the utility, usability, and reliability of the application still need development. However, we can see that assessing the status of wisdom in the Wisdom Cube and understanding the personal degree of wisdom can already help leaders and managers to focus on improving the right dimensions, planes, and attributes in their current professional position. Leaders and managers can also experience, after the evaluation, how they have prioritized their leadership traits.

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