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MEASUREMENT OF INTELLECTUAL CAPITAL IN AGRICULTURAL ENTERPRISES: A CASE STUDY IN POLAND

Abstract:

This paper discusses the possible ways of measuring intellectual capital in agricultural enterprises. Of the many available methods, VAIC™ by A. Pulić was assumed to be the most useful one. It was implemented for the purposes of research and to enable an empirical verification based on financial data of 148 agricultural enterprises. The analysis of results and the discovered deviations from substantive findings resulted in proposing a new indicator of Intellectual Sources of Value Added (ISVA) which was empirically verified using the same sample of businesses. The results suggest that ISVA provides a much more realistic reflection of the processes of value added creation from intellectual capital in agricultural enterprises. It also demonstrates that new value is created in a context of complementarity between tangible and intangible inputs which together provide the agricultural enterprises with a key to growth of efficiency.

Keywords:

intellectual capital, value added, agricultural holding performance, micro analysis of farms, intellectual capital measurement

JEL Classification: G32, L25, O12

1 Introduction

The problem of using intangible balance sheet assets in agricultural activities was first tackled in the 1950s–1960s (White 1995, p. 437-445). These first papers addressed the issue of R&D investment efficiency in the agriculture sector (Alston 1986, p. 1–9), the assessment of agriculture-related and education services (Allaire-Arrive 2007) and the role of knowledge and intangible resources in agriculture (Moor, Craig 2008, p. 3–20). The importance of intangible resources to integration processes was also assessed (Goldsmith, Hamish 2005, p. 1–21). However, no one addressed the issue of intellectual capital, a category which emerged in agriculture through the research carried in biotech companies (Fulton, Murray, Giannakas 2002, Sporleder, Moss 2004, p. 26–36). To date, there have been no papers with direct references to agriculture and agricultural enterprises.

Therefore, the purpose of this paper is to present the results of research on the effective use of intellectual capital in value added generation for agricultural enterprises. When implementing the measurement methods which describe the use of intellectual capital in value added generation for non-agricultural enterprises, an alternative proprietary index (Intellectual Sources of Value Added) was proposed which may also be used in the agricultural context. The starting point for the research presented in this paper is the analysis of a popular business index, VAIC™ by A. Pulić (2000) . Both indexes were calculated based on data from annual financial statements (balance sheets and P&L accounts) covering a 10-year period of uninterrupted operation of 148 agricultural enterprises with diversified activities.

2 - Intellectual Capital and Its Measurement

It is still difficult to indicate a single method for intellectual capital measurement, even though intellectual capital is increasingly recognized as a key resource of 21st century businesses. Most papers which are believed to be fundamental for the development of the intellectual capital concept focus on the analysis of sectors involving high levels of knowledge absorption (insurance, banking, IT, high tech etc.), and therefore propose measurement methods and models which are adequate in that very context. Papers by the following authors are considered to have had a key contribution to research: Bontis (1996), Edvinsson and Malone (1997), Stewart (1997), Pulić (1998, 2000), Sveby (2000, 2001), Lev (2001). They emphasize the intangible nature of intellectual capital and its role as a strategic resource which enables sustainable development and better financial performance (Barney 1991).

Intellectual capital is derived as the difference between the book value and market value of an enterprise (Edvinsson, Malone 2001), and is also described as the complementary

impact of human and structural factors (Bontis 1996). Many authors cite these very factors as a prerequisite for intellectual capital formation. However, intellectual capital could not become fully operational without the third component, i.e. financial capital which is an indicator of physical resources (Edvinsson 1991, Stevart 1997, Lowendahl 1997, Bontis, Dragoinetti, Jackobsen and Ross, 1999, et al.). The available research reports are based on different concepts for the measurement of intellectual capital or its efficiency.

This paper focuses on VAIC™ (Value Added Intellectual Coefficient), an index by A. Pulić who proposed to measure intellectual capital efficiency in value creation processes. He believed the efficiency of intellectual capital to be a measurable outcome of using the available resources of tangible and intangible assets (which may be determined based on standard financial reports). As a consequence, VAIC™ became widely adopted by business and academic communities (Firer and Williams 2003, p. 348–360, Kunasz 2006, p. 15–21, et al.).

According to A. Pulić, VAIC may be determined based on annual financial statements which allow to specify the value of particular terms of the relevant calculation formula, i.e.:

- value added, as the difference between operating profit/loss and the company's operating expenditure; or as the total of operating profit, labor costs, depreciation and impairment losses,
- physical resources as the net book value of assets,
- intangible resources:
    - human capital as the sum of the company's expenditure on staff,
    - structural capital, as the difference between value added and human capital.

The calculated VAIC™ index reflects the contribution of all resources (with an indication of their tangible or intangible nature) to value added. This means the higher the value of the index, the better is the company's ability to transform its resources into measurable financial values.

Just as most models, VAIC™ reflects the operational realities in a simplified way. Discussions are still ongoing in the scientific community on whether it complies with the fundamental economic principles according to which productive inputs may take the form of resources and flows. The failure to make that distinction is a common mistake. From the economic point of view, total tangible resources of the enterprise (measured by A. Pulić as the net asset value) do not participate in the value added creation process; instead, a contribution to value added is made by streams of tangible enterprise resources (measured

as the value of consumption they bring to products and services). Their cumulative year-end value is the sum of depreciation and materials, energy and external services consumption. Also, the economic performance of an enterprise, traditionally measured as net profit, reflects the balance of cumulative incomes and costs within a specific period, and represents the flows which ultimately affect the changes in productive input resources at a given time (usually, end of year).

Taking the above into consideration, the author made an attempt to develop an alternative indicator based on a homogenous category of flows. It is a direct reference to intellectual capital defined as a set of intangible flows (Bontis, Dragonetti, Jacobsen and Ross, 1999). The proposed index is referred to for convenience as “Intellectual Sources of Value Added” (ISVA). The essence of ISVA is to show the efficiency of material expenditure (consumption of fixed and current assets) and intellectual inputs (knowledge, skills, experience and other factors related to human labor and its organization) used in business operations. The efficiency of inputs was assumed to be a reliable indicator of productivity which also shows the role of tangible and intangible sources of value added (Kulawik 2009, p. 33–49).

The following was calculated using the implemented ISVA algorithm:

- productivity of value added creation based on material expenditure, calculated as follows:

$$PME = VA/ME \quad (1)$$

where:

PME - productivity of tangible (material) expenditures

VA - value added

ME - tangible (material) expenditures

- the productivity of expenditure on staff was calculated as follows:

$$PES = VA/ES \quad (2)$$

where:

PES - productivity of expenditure on staff

VA - value added

ES - expenditure on staff

- the productivity of organizational and operational expenditure was calculated as follows:

$$PEO = VA/EO \quad (3)$$

where:

PEO - productivity of organizational and operational expenditure of a company

VA - value added

EO - other expenditure on organization and activity (calculated as total expenditures less tangible and staff expenditure)

- ISVA (intellectual sources of value added) was calculated as the total of the above sub-indexes:

$$ISVA=PTE+PES+PEO \quad (4)$$

The index calculated as the productivity of expenditure on staff plus productivity of organizational expenditure provides information on the productivity of corporate expenditure on intellectual (intangible) inputs, expressed as follows:

$$PIE = PES+PEO \quad (5)$$

where:

PIE - productivity of intellectual inputs (expenditure)

PES - productivity of expenditure on staff

PEO - productivity of organizational and operational expenditure of a company.

Empirical ISVA values specify the productivity of expenditure on value added incurred by the company while also taking into consideration the flow-based nature of expenditure, which seems to provide a more essential picture of intellectual capital.

The method presented in this paper is based on the following assumptions:

- value added is the total of: depreciation, remunerations, social insurance and other employee benefits, agricultural tax and fees, interest, income tax and net profit,

- material expenditure reflects the consumption of fixed and current assets (total of depreciation and materials, energy and external services consumption),

- intangible (intellectual) expenditure reflects the labor inputs (total of remunerations, social insurance and other employee benefits) and other organizational and operational inputs (total of taxes and fees, other prime costs, other operating costs, and value of goods and materials sold),

- the sum of tangible and intangible inputs (expenditure) expresses the total value of expenditure incurred in the reporting period.

3 - Results

As a part of the research process, VAIC™ and the proprietary ISVA index were subject to empirical testing. The changes in intellectual capital contribution to value added in 148 agricultural enterprises were analyzed in the 2002–2011 period. The values of both indexes estimated for the pre-EU period (2002–2004) were found to considerably differ from those

estimated for the subsequent period. This is consistent with the evolution of other economic parameters of enterprises covered by this study. These developments reflect the changing realities of farming which enable a gradual improvement of the companies' technical and organizational infrastructure, including better availability of state-of-the-art machinery, equipment and IT technologies (Tomaszewska, 2013; Kijak, 2013; Kocira, Lorentowicz, 2011; Kozera, 2014).

The calculated VAIC™ shows that the companies covered by this study experienced an increase in the total efficiency of tangible and intangible assets (measured with value added) (Table 1).

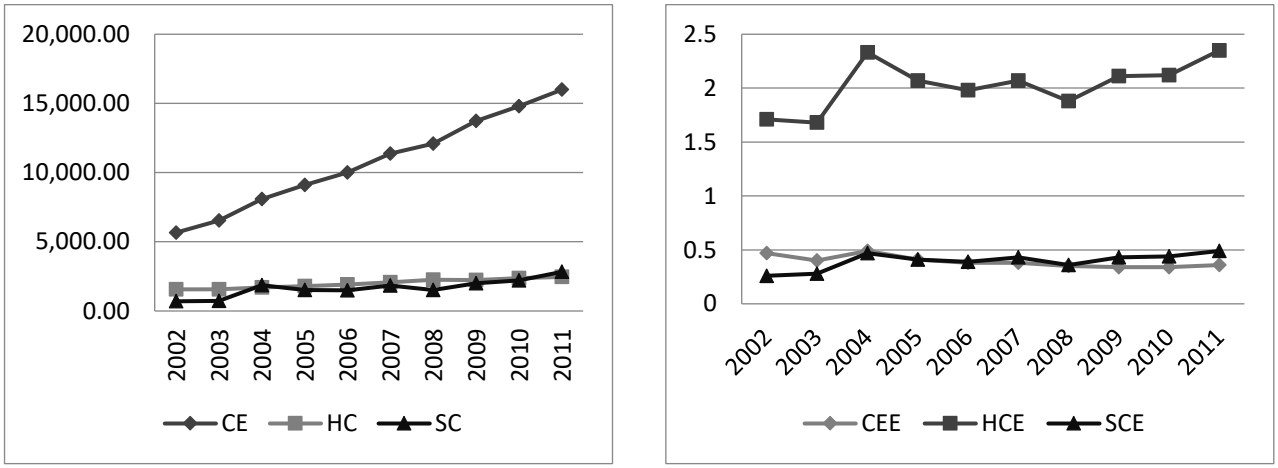
Table 1: Average level and efficiency of value added creation by tangible and intangible assets (VAIC™) in agricultural companies covered by this study

Years	*Resources (PLN thousand)*				*Efficiency*			VAIC
	Employee capital (CE)	*Intangible*		*Value added* (VA)	Employee capital *Efficiency* (CEE)	Human Capital *Efficiency* (HCE)	Structural Capital *Efficiency* (SCE)	
		Human capital (HC)	*Structural capital* (SC)					
2002	5,666.13	1,569.42	701.41	2,608.82	0.47	1.71	0.26	2.45
2003	6,539.24	1,567.74	728.92	2,616.04	0.40	1.68	0.28	2.36
2004	8,084.63	1,690.89	1,861.15	3,896.59	0.49	2.33	0.47	3.29
2005	9,103.58	1,797.34	1,519.14	3,656.12	0.41	2.07	0.41	2.89
2006	10,009.89	1,919.22	1,495.97	3,731.02	0.38	1.98	0.39	2.75
2007	11,362.50	2,083.01	1,836.66	4,264.02	0.38	2.07	0.43	2.88
2008	12,093.38	2,264.27	1,525.60	4,246.76	0.35	1.88	0.36	2.59
2009	13,729.11	2,230.94	2,008.35	4,694.71	0.34	2.11	0.43	2.88
2010	14,788.20	2,379.68	2,217.73	5,014.29	0.34	2.12	0.44	2.90
2011	15,990.80	2,462.28	2,825.60	5,726.94	0.36	2.35	0.49	3.20

Source: own study

The analysis of sub-indexes suggests that it was the consequence of two divergent trends: a decline in physical capital efficiency (CEE) from ca. 0.5 to 0.3, and an increase in intellectual capital efficiency (HCE+SCE) from ca. 2.0 to 2.8. This proves the growing role of intellectual resources associated with employees and organizations (Figure. 1).

Figure 1: Average level (PLN thousand) and efficiency of value added creation (VAIC™) by tangible and intangible assets



Source: Table 1

The results provided by ISVA, an alternative to VAIC, largely confirm the role of intangible inputs in value added creation. Also, these results enable a more realistic assessment of the productivity of economically homogeneous categories of tangible (material) and intangible expenditure streams incurred by agricultural enterprises in value added creation processes.

Detailed analyses of these results provide a much more accurate reflection of developments affecting the farming practice. In the study period, material expenditure (ME) nearly doubled (177%), demonstrating a higher growth rate than intangible inputs (remunerations: 157%, other: 151%). The higher growth rate of the former confirms the improved availability of technical and production equipment, expressed as the sum of depreciation and materials and external services purchased. A slower growth of intangible expenditure on staff (ES) and of organizational and operational expenditure (EO) reflects a more rational use of the companies' own assets. This is confirmed by the fact that value added grew faster than expenditure, at a rate of 215% in 2002–2011. The above is also reflected by the values of sub-indexes and of the cumulative ISVA index, as calculated under this test procedure (Table 2).

Table 2: Level and productivity of value added creation by tangible and intangible inputs in agricultural companies covered by this study

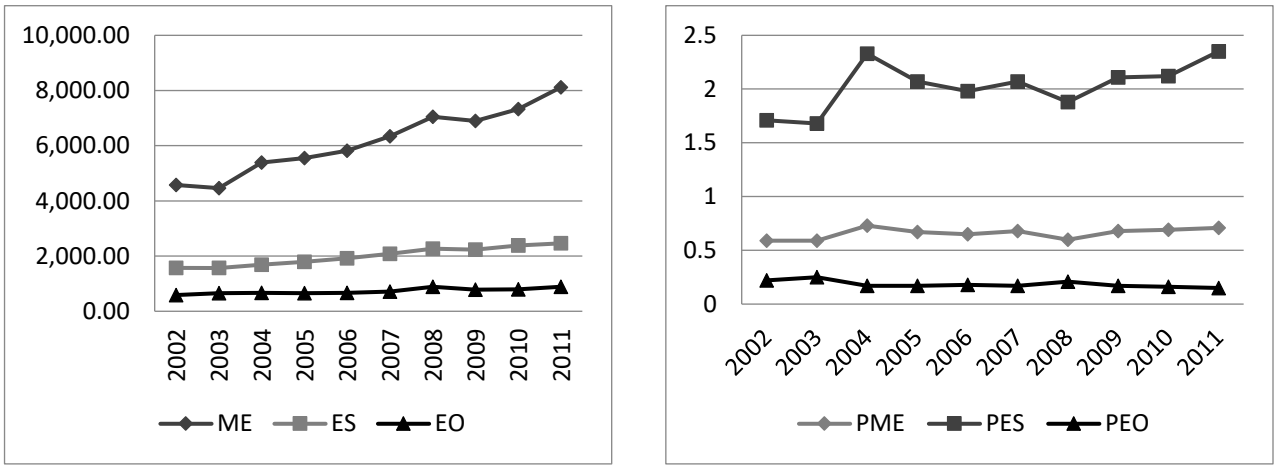
Years	*Expenditures*			*Value Added (VA)*	Productivity of *expenditures*			ISVA
		Intangible				*Intangible*		
	Material Expenditures (ME)	*Expenditures on Staff (ES)*	*Expenditures on Organization (EO)*		*Productivity of Material Expenditures (PME)*	*Productivity of Expenditures on Staff* (PES)	*Productivity of Expenditures on Organization* (PEO)	
2002	4,573.13	1,569.42	587.98	2,689.55	0.59	1.71	0.22	2.52
2003	4,461.81	1,567.74	652.66	2,631.72	0.59	1.68	0.25	2.52
2004	5,388.97	1,690.89	672.79	3,932.71	0.73	2.33	0.17	3.23
2005	5,552.35	1,797.34	651.03	3,722.23	0.67	2.07	0.17	2.92
2006	5,813.56	1,919.22	667.80	3,793.59	0.65	1.98	0.18	2.81
2007	6,339.50	2,083.01	711.78	4,313.34	0.68	2.07	0.17	2.92
2008	7,049.68	2,264.27	884.44	4,254.71	0.60	1.88	0.21	2.69
2009	6,895.53	2,230.94	781.13	4,714.84	0.68	2.11	0.17	2.96
2010	7,322.64	2,379.68	797.41	5,040.61	0.69	2.12	0.16	2.96
2011	8,118.24	2,462.28	889.21	5,786.97	0.71	2.35	0.15	3.22

Source: own study

Throughout the study period, ISVA was fluctuating around the average level of 2.9 (from a minimum of 2.5 in 2002 to a maximum of 3.2 in 2011). The productivity of intangible inputs (expenditure on organization and staff) had a decisive impact on ISVA (with 2.5 units of value added per 1.9 units of expenditure). The productivity of tangible inputs ranged from 0.6 to 0.7 and had a much smaller contribution to value added. Because the productivity of intangible inputs grew faster (132%) than that of tangible (material) inputs (116%) in the study period, the former have clearly grown in significance (Fig. 2). It may be therefore concluded that value growth was mainly driven by intangible inputs enabled by an increase in the productivity of tangible (material) inputs. This means agricultural enterprises covered by this study made an effective use of complementarities between these inputs and were able to effectively generate new value based on synergies. The increased use of tangible (material) inputs due to use of technically more efficient machinery and equipment,

sophisticated seed and breeding material etc. drove the improvement in employee knowledge and skills.

Figure 2. Level and productivity of Intellectual Sources of Value Added (ISVA) (PLN thousand)



Source: Table 2

When plotted on a diagram, these developments show a nearly linear growth of inputs (at various levels and growth rates), among which tangible (material) inputs prevail. Intangible inputs (expenditure on human and organizational capital) were the most productive ones. On a longer term, this may result in a higher productivity of total expenditure, driven by progress in technology and computer science and by employee knowledge and skills.

4 - Conclusion

In the 2010s, focus is placed on extending both the subject matter of agricultural research and the related measurement toolkit. This is especially important for intangible balance sheet assets and their impact on farming efficiency. The related research is facilitated by various kinds of adaptations of intellectual capital measurement methods which confirm that intellectual capital may (and should be) measured. This paper presents the author's own approach to that issue, i.e. the index of Intellectual Sources of Value Added. In addition to considering productive inputs as streams (which is consistent with economic principles) ISVA provides a much more complete picture of patterns found in farming processes than other previously used indexes. This is especially true for the level of tangible (material) inputs used which has grown after the accession to the EU, and has therefore been a major development driver for the Polish agriculture industry. Calculated in line with the author's own ISVA concept, the productivity of expenditure on tangible assets grows, though at a slower rate than the productivity of expenditure on human resources and organization. Calculated with the use of VAIC™, the efficiency of tangible (material) inputs follows a

downward trend, which is contrary to the principles of rational management. It was similar for the expenditure on organizational and operational expenditure incurred in parallel to structural capital in A. Pulić's method. The findings from the alternative method suggest that these inputs are used more effectively, which confirms the importance of an efficient infrastructure in supplementing the intellectual efforts of humans.

The empirical study enabled the validation of the implemented measurement method (VAIC™) in a context of agricultural research while also revealing its deficiencies. As a consequence, an alternative proprietary indicator of Intellectual Sources of Value Added (ISVA) was proposed. The results of research based on the above method for the measurement of intellectual capital in agricultural enterprises provide an incentive for further studies on the usability of ISVA as a set of complementary indexes for a business analysis of agricultural operators.

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