Estimation of the Complexity of Business Sectors Covered by ERP Solutions

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Abstract. *The paper describes a method for the estimation of the complexity of business sectors covered by ERP solutions. It presents a short overview of existing methods for measuring the complexity of business sectors and software in general, including the ERP solutions as its special type. The list of business sectors which are supported by ERP solutions is given, over which the described method for the estimation of complexity is applied.*

Keywords. Business sectors, ERP solutions, complexity

1 Introduction

Business sector is the sum of all actions a commercial business organization performs in order to create benefit; including the actions a non-commercial business organization performs in order to fulfil its mission. [7]

Every business organization, profit or non-profit, accomplishes its goals by performing a set of connected business activities (i.e. business processes). Which business activities are performed by a certain business organization depends on what business sector the business organization is involved in. For example, a business organization involved in banking performs a set of connected business activities which are not performed by a business organization which is in the production of furniture. Therefore, the business sector classifies business activities.

Business software belongs to a group of special-purpose user software which are developed for monitoring the business function in specific business organization. In this group there are also applications for working with data of certain business functions (procurement, sales, production, finances and accounting, etc.). There are also applications which are developed for certain business sectors: shipping, banking, payment operations, police, cadastre, etc.

Business software covers exactly a certain structure of a business organization, i.e. a certain business technology. It can be said that this software is a model of the business technology. Based on the business technology, which was a model for developing software, the business software can be grouped into two classes: a custom made business software and a general business software. The first was created based on the business technology of that business organization for which the software was intended in the first place, while the other one was created based on the business technology developed by the 'best practice' method – as claimed by producers of business software. The 'best practice' method should result in a business technology which is created out of a number of business technologies from different business organizations. The creation of 'best practice' is not explored to a satisfying degree in scientific literature. The article "The creation of 'best practice' software: Myth, reality and ethics" attempts at giving the answer to the question "How are 'best practices' created and embedded in new ERP software?" through the presentation of case studies in which follows the creation of the ERP product destined to be marketed as a best practice solution for higher education institutions (see [14]).

If it is claimed that certain business software supports a certain business sector, then it means that it supports those business processes which are specific for the observed business sector. Therefore, this is a case of specialization of business software. Here we can differentiate business software which supports only business processes specific for a certain business

sector (business processes which are not specific are not supported) – this is specialization of the highest degree, and business software which supports specific business processes of a certain business sector, but also supports certain unspecific processes (e.g. business processes for managing human resources, procurement, sales, etc.) – this is specialization of a lower degree. Producers of business software emphasize which business sector their solution supports. Large-scale producers of business software (IBM, ORACLE, SAP, Microsoft) offer solutions adapted to different business sectors, and in effect they have developed their own commercial classifications of supported business sectors (see [4], [9], [11], [12]). Such classifications are first and foremost used commercially, to identify business sectors which are supported by their business software.

One sort of existing business software is the ERP solution. The producers of modern ERP solutions have reported the existence of business functional areas common to a certain group of business sectors (e.g. manufacturing, service, financial services, public services, etc.). Due to that, general business software has emerged. It is applicable to different business sector, being a general ERP solution. However, business sector, no matter if they belong to the same or different group, have specific areas which are not supported in general ERP solutions. In this case, the verticalization of ERP solutions is introduced. The verticalization of ERP solution can be defined as a process of expanding, modifying or adjusting the general ERP solution by enforcing specific qualities of a certain business sector. The result of this procedure is a specialized ERP solution which supports business processes of the given business sector. [7]

2 Motivation

The paper "Analysis and Classification of ERP Producers by Business Operations" (see [7]) shows the analysis of business sectors which are supported by different ERP solutions. Table 1 shows the list of analysed business sectors.

Table 1. Business sectors supported by ERP solutions

Business sector
1. Banking
2. Capital Markets
3. Insurance
4. Defense logistics (Defense & Security)
5. Public Security (Defense & Security)
6. Healthcare payers (Healthcare)
7. Healthcare providers (Healthcare)
8. Schools (Education & Research)
9. Higher Education (Education & Research)
10.Research (Education & Research)
11. Government (Public Sector)
12. Public Security (Public Sector)
13. Aerospace and Defense Manufacturers (Aerospace & Defense)
14. Airline Management (Aerospace & Defense)
15. MRO/M&E Service Providers (Aerospace & Defense)
16. Automotive OEMs (Automotive)
17. Sales and Service Organizations (Automotive)
18. Automotive Suppliers (Automotive)
19. Chemicals
20. Shipbuilding
21. Agricultural
22. Apparel and Footwear (Consumer Products)
23. Beverage (Consumer Products)
24. Consumer Durables and Home Appliances (Consumer Products)
25. Food (Consumer Products)
26. Home and Personal Care (Consumer Products)
27. Industrial Machinery & Components
28. Business, Medical, and Consumer OEMs (High Tech)
29. Electronics Manufacturing Service Providers (High Tech)
30. Semiconductor and Component Manufacturers (High Tech)
31. Software Providers (Hih Tech)
32. Industrial Machinery & Components
33. Pharmaceuticals (Life Sciences)
34. Biotechnology/Biopharmaceuticals (Life Sciences)
35. Medical Device/Scientific Instruments (Life Sciences)
36. Building Materials (Mill Products)
37. Fabricated Metal Products (Mill Products)
38. Furniture (Mill Products)
39. Packaging (Mill Products)
40. Plastics (Mill Products)
41. Primary Metals (Mill Products)
42. Pulp and Paper (Mill Products)
43. Textile (Mill Products)
44. Rubber (Mill Products)
45. Timberlands and Solid Wood (Mill Products)
46. Mining
47. Oil & Gas
48. Logistics Services
49. Broadcasting (Media)
50. Entertainment (Media)
51. Newspapers and Magazines (Media)
52. Premium Content Publishers (Media)
53. Postal Services
54. Professional Services
55. Railways
56. Marine Transportation
57. Retail
58. Facilities Management
59. Not for Profit & Charities
60. Rental
61. Hospitality
62. Real Estate
63. Telecommunications
64. Generation (Utilities)
65. Retail (Utilities)
66. Transmission and Distribution (Utilities)
67. Gas (Utilities)
68. Waste (Utilities)
69. Water (Utilities)
70. Wholesale Distribution

A few questions emerge: what is the total and average complexity of the listed business sectors, are there common and specific elements of a certain business sector which constitute its complexity, and in what average relation are these common and specific elements of the business sector?

2.1 The Complexity of the Business Sector

Unlike the complexity of a business organization, the complexity of the business sector is poorly covered in

literature, and there are no unique indicators of complexity. Because of this fact, the indicators for complexity of the business sector are: number of different occupations in a certain sector [8], time needed to start a business sector with the corresponding experience and education [1], the number of business organizations, the distribution of the size of business organizations, interaction, i.e. the degree of networking [16] etc.

The complexity of a business sector can be presented through the complexity of business organizations which are involved in the sector, through vertical, horizontal and spatial complexity.

Horizontal complexity represents division of tasks in an organization and the greater the division of tasks is, the organization is more complex, and vice versa. Vertical complexity represents division of organization through organization's management levels, and the greater the number of levels is, the more complex is the organization, and vice versa. The degree of task division and specialization in an organization are closely related to the horizontal and vertical complexity of a business organization. [13]

Spatial complexity represents the number of geographical locations of the business organization. The larger that number is, the higher is the complexity of the business organization.

One of the ways to connect the complexities of business organizations is through the middle value of complexity. In this way the complexity of a business sector is presented as the average complexity (vertical, horizontal or spatial) of business organizations which are involved in the sector. Depending on which complexity is in the focus, the unit of measure can be the average number of organizational levels, organizational units or locations. The larger that number, the greater is the complexity of the observed business sector.

2.2 The Complexity of Business Software

The complexity of a software (as well as business software, as its special form) is shown in different ways: counting the Line of Code (LOC) – used to measure size as well, Halstead volume or Cyclomatic number. [10] All these indicators show the complexity of software from the perspective of the complexity of implemented algorithms.

Measuring the complexity of software through LOC represents the first way of measuring which emerged in 1960. [2] As the number of LOC increases, so the software gets more and more complex. The unit of measure is LOC (line of code). The advantage of using this method is its simplicity. However, it has a set of limitations like: dependence one the programming language, dependence on the software design (a poor design can create more lines of code), users find the measure difficult to understand, etc.

Halstead volume (the metrics emerged in 1977) measures the complexity of software through the number of operations and operands which emerge in the implementation of the algorithm. Due to this, the metrics is not sensitive to the appearance of the code, like the metrics measuring complexity through LOC is. [10] The software which has a higher Halstead volume is more complex.

If we mark the number of different operators with n_1, and the number of different operands with n_2, the number of all operators with N_1, the number of all operands with N_2, then we get the Halstead volume V through the following expression: [8]

$$V = (N_1+N_2)\ log_2\ (n_1+n_2)$$

The Cyclomatic number was introduced by McCabe in 1976. It measures complexity of a software through the analysis of the flow of the programme. [10] The software is seen as a directed graph where the edges represent the flow of programme control, and the nods linear code segments. The Cyclomatic number represents the number of linearly independent paths of running the programme. [8] The larger is the cyclomatic number of a software; the greater is its complexity.

The cyclomatic number is reached through the following expression: [3]

$$V(G) = e - n + 2$$

where e is the number of edges, and n is the number of nods in graph G.

The metrics which measures software through the cyclomatic number is not sensitive to the complexity of data structure, data flow, and the complexity of interface of programming modules. [10]

3 Methodology

The presented methods for measuring the complexity of business sectors are generally difficult to apply, and therefore are not appropriate for measuring the total and average complexity of business sectors covered by ERP solutions. Consequently, the estimation of total and average complexity of business sectors is proposed, based on the measured complexity of ERP solution and the list of business sectors which are supported by the observed ERP solution. However, the question is how to measure the complexity of ERP solution? The presented methods for measuring business software are not appropriate for measuring the total complexity because they demand an analysis of most algorithms which are implemented within the observed ERP solution. This is why a new metrics is defined for measuring the complexity and importance of its elements (functional areas and activities). This metrics is based on the estimation of complexity of elements of business software through a measuring scale of complexity, and based on the estimation of importance of elements through a measuring scale of importance. Then, the total complexity of business software is

calculated as the sum of multiplications of complexity and the importance of its elements. This metrics is described in detail in the paper "Measuring the complexity of the business sector and business software" (see [6]). Table 2 shows the measuring scale of importance, and Table 3 measuring scale of complexity.

Table 2. Measuring scale of importance for estimating the importance of elements

Description	Value	Probability of occurrence
High importance	1	0.1
Medium high importance	0.9	0.2
Medium importance	0.7	0.4
Medium low importance	0.3	0.2
Low importance	0.1	0.1

The measuring scale of importance consists of five values. Each of the values in the scale was assigned with the probability of occurrence of the observed level of importance (this is a number in the interval [0, 1] with the property that their total sum by the values of the scale is 1). The probability distribution is based on the assumption that, generally, the level of importance of elements in nature is distributed by normal (Gauss) distribution. Based on the probability of occurrence of a certain level of importance, the numeric values are defined in a manner that summed up they cover the interval [0, 1]. This is the result:

- "Low importance": 0 + 0.1 = 0.1
- "Medium low importance": 0.1 + 0.2 = 0.3
- "Medium importance": 0.3 + 0.4 = 0.7
- "Medium high importance": 0.7 + 0.2 = 0.9
- "High importance": 0.9 + 0.1 = 1

Table 3. Measuring scale of complexity for estimation of the complexity of elements

Description	Value	Probability of occurrence
High complexity	1	0.1
Medium high complexity	0.9	0.2
Medium complexity	0.7	0.4
Medium low complexity	0.3	0.2
Low complexity	0.1	0.1

This measuring scale was created on the same basis as the measuring scale for estimation of importance.

The unit of measure of the estimated importance is UI (Unit of Importance), while the unit of measure of estimated complexity is UC (Unit of Complexity). The unit of measure of the complexity calculated using the estimated importance and complexity of functional areas of the observed software is UACF (the Unit of Adjusted Complexity of Functional areas).

4 Results

As the basis for the estimation of the complexity of 70 business sectors supported by ERP solutions (see Table 1), the ERP solution Microsoft Dynamics NAV 5.0 was chosen. Table 4 shows the list of functional areas of the observed ERP solution, and calculated complexities.

Table 4. Calculated complexity of ERP solution Microsoft Dynamics NAV 5.0 through estimated complexity and importance of its functional areas

Functional Area	Complexity of Functional Area (UC)		Importance of Functional Area (UI)		Multiplication of Complexity and Importance
1. Financial Management	0.7 + 0.7 + 0.7 + 0.3 + 0.7 + 0.3 + 0.3 + 0.7 + 0.9 + 0.7 + 0.7 + 0.9 + 0.7 + 0.7 + 0.9 + 0.7 + 0.3 + 0.7 + 0.3 + 0.7 + 0.3 + 0.7 + 0.7 + 0.7 + 0.3 + 0.3 + 0.3 + 0.3 + 0.3 = 16.5 UC 0.7 + 0.07 + 0.21 + 0.3 + 0.21 + 0.3 + 0.09 + 0.63 + 0.9 + 0.21 + 0.7 + 0.9 + 0.21 + 0.7 + 0.9 + 0.21 + 0.03 + 0.7 + 0.27 + 0.49 + 0.3 + 0.7 + 0.7 + 0.7 + 0.09 + 0.21 + 0.09 + 0.09 + 0.21 = 11.82 UACF				
1.1. General Ledger	Medium	0.7	High	1	0.7
1.1.1. Intercompany Postings	Medium	0.7	Low	0.1	0.07
1.1.2. Periodic Activities	Medium	0.7	Medium low	0.3	0.21
1.1.2.1. VAT	Medium low	0.3	High	1	0.3
1.1.2.2. Currency	Medium	0.7	Medium low	0.3	0.21
1.1.2.3. Fiscal Year	Medium low	0.3	High	1	0.3
1.1.2.4. Consolidation	Medium low	0.3	Medium low	0.3	0.09
1.2. Cash Management	Medium	0.7	Medium high	0.9	0.63
1.3. Receivables	Medium high	0.9	High	1	0.9
1.3.1. Periodic Activities	Medium	0.7	Medium low	0.3	0.21
1.3.2. Setup	Medium	0.7	High	1	0.7
1.4. Payables	Medium high	0.9	High	1	0.9
1.4.1. Periodic Activities	Medium	0.7	Medium low	0.3	0.21
1.4.2. Setup	Medium	0.7	High	1	0.7
1.5. Fixed Assets	Medium high	0.9	Extremely high	1	0.9
1.5.1. Periodic Activities	Medium	0.7	Medium low	0.3	0.21
1.5.1.1. Index	Medium low	0.3	Low	0.1	0.03
1.5.2. Setup	Medium	0.7	High	1	0.7
1.6. Inventory	0.3 + 0.7 + 0.3 + 0.7 + 0.7 + 0.7 + 0.3 + 0.3 + 0.3 + 0.3 + 0.3 = 4.9 UC 0.27 + 0.49 + 0.3 + 0.7 + 0.7 + 0.7 + 0.09 + 0.21 + 0.09 + 0.09 + 0.21 = 3.85 UACF				
1.6.1. Costing	Medium low	0.3	Medium high	0.9	0.27
1.6.2. Setup	Medium	0.7	Medium	0.7	0.49
1.7. Setup	Medium low	0.3	High	1	0.3
1.7.1. Posting Groups	Medium	0.7	High	1	0.7
1.7.1.1. General	Medium	0.7	High	1	0.7
1.7.2. VAT Posting Group	Medium	0.7	High	1	0.7
1.7.3. Trail Codes	Medium low	0.3	Medium low	0.3	0.09
1.7.4. Dimensions	Medium low	0.3	Medium	0.7	0.21
1.7.5. Intercompany Postings	Medium low	0.3	Medium low	0.3	0.09
1.7.6. Instrastat	Medium low	0.3	Medium low	0.3	0.09
1.7.7. General	Medium low	0.3	Medium	0.7	0.21
2. Sales & Marketing	0.7 + 0.3 + 0.3 + 0.9 + 0.7 + 0.7 + 0.1 + 0.1 + 0.3 + 0.3 + 0.1 + 0.1 + 0.1 + 0.3 + 0.1 = 5.1 UC 0.7 + 0.3 + 0.27 + 0.9 + 0.63 + 0.63 + 0.09 + 0.09 + 0.27 + 0.27 + 0.09 + 0.03 + 0.03 + 0.09 + 0.03 = 4.42 UACF				
2.1. Sales	Medium	0.7	High	1	0.7
2.1.1. Setup	Medium low	0.3	High	1	0.3
2.1.1.1. Opportunity	Medium low	0.3	Medium high	0.9	0.27
2.2. Order Processing	Medium high	0.9	Medium high	1	0.9
2.2.1. Setup	Medium	0.7	Medium high	0.9	0.63
2.3. Marketing	Medium	0.7	Medium high	0.9	0.63
2.3.1. Setup	Low	0.1	Medium high	0.9	0.09
2.3.1.1Campaign	Low	0.1	Medium high	0.9	0.09

2.3.1.2Profile	Medium low	0.3	Medium high	0.9	0.27
2.4. Inventory & Pricing	Medium low	0.3	Medium high	0.9	0.27
2.5. Setup	Low	0.1	Medium high	0.9	0.09
2.5.1. Company	Low	0.1	Medium low	0.3	0.03
2.5.2. Organizational Profile	Low	0.1	Medium low	0.3	0.03
2.5.3. Interaction	Medium low	0.3	Medium low	0.3	0.09
2.5.4. To-do	Low	0.1	Medium low	0.3	0.03
3. Purchase					0.9 + 0.1 + 0.9 + 0.1 + 0.7 + 0.1 + 0.1 + 0.1 = 3 UC 0.9 + 0.1 + 0.9 + 0.1 + 0.49 + 0.07 + 0.07 + 0.1 = 2.73 UACF
3.1. Planning	Medium high	0.9	High	1	0.9
3.1.1. Setup	Low	0.1	High	1	0.1
3.2. Order Processing	Medium high	0.9	High	1	0.9
3.2.1. Setup	Low	0.1	High	1	0.1
3.3. Inventory & Costing	Medium	0.7	Medium	0.7	0.49
3.3.1. Costing	Low	0.1	Medium	0.7	0.07
3.3.2. Setup	Low	0.1	Medium	0.7	0.07
3.4. Setup	Low	0.1	High	1	0.1
4. Warehouse					0.3 + 0.9 + 0.3 + 0.3 + 0.7 + 0.7 + 0.7 + 0.7 + 0.3 = 4.9 UC 0.21 + 0.9 + 0.27 + 0.3 + 0.63 + 0.63 + 0.21 + 0.49 + 0.3 = 3.94 UACF
4.1. Orders & Contacts	Medium low	0.3	Medium	0.7	0.21
4.2. Planning & Execution	Medium high	0.9	High	1	0.9
4.2.1. Setup Inventory	Medium low	0.3	High	0.9	0.27
4.2.2. Setup Warehouse	Medium low	0.3	High	1	0.3
4.3. Goods Handling Order by Order	Medium	0.7	Medium high	0.9	0.63
4.4. Goods Handling Multiple Orders	Medium	0.7	Medium high	0.9	0.63
4.4.1. Periodic Activities	Medium	0.7	Medium low	0.3	0.21
4.5. Inventory	Medium	0.7	Medium	0.7	0.49
4.6. Setup	Medium low	0.3	High	1	0.3
5. Manufacturing					0.7 + 0.3 + 0.3 + 0.1 + 0.9 + 0.9 + 0.7 + 0.3 = 4.2 UC 0.7 + 0.27 + 0.09 + 0.09 + 0.9 + 0.9 + 0.49 + 0.3 = 3.74 UACF
5.1. Product Design	Medium	0.7	High	1	0.7
5.2. Capacities	Medium low	0.3	Medium high	0.9	0.27
5.2.1. Absence	Medium low	0.3	Medium low	0.3	0.09
5.2.2. Setup	Low	0.1	Medium high	0.9	0.09
5.3. Planning	Medium high	0.9	High	1	0.9
5.4. Execution	Medium high	0.9	High	1	0.9
5.5. Costing	Medium	0.7	Medium	0.7	0.49
5.6. Setup	Medium low	0.3	High	1	0.3
6. Jobs (total complexity)					0.7 + 0.3 + 0.1 = 1.1 UC 0.7 + 0.21 + 0.1 = 1.01 UACF
6. Jobs	Medium	0.7	High	1	0.7
6.1. Periodic Activities	Medium low	0.3	Medium	0.7	0.21
6.2. Setup	Low	0.1	High	1	0.1
7. Resource Planning (total complexity)					0.7 + 0.7 + 0.3 = 1.7 JS 0.7 + 0.49 + 0.3 = 1.49 UACF
7. Resource Planning	Medium	0.7	High	1	0.7
7.1. Periodic Activities	Medium	0.7	Medium	0.7	0.49
7.2. Setup	Medium low	0.3	High	1	0.3
8. Service					0.7 + 0.3 + 0.1 + 0.1 + 0.1 + 0.9 + 0.1 + 0.3 + 0.1 + 0.1 + 0.1 + 0.3 + 0.3 + 0.1 = 3.5UC 0.63 + 0.21 + 0.09 + 0.09 + 0.1 + 0.9 + 0.03 + 0.21 + 0.07 + 0.07 + 0.21 + 0.3 + 0.1 = 3.01 UACF
8.1. Contract Management	Medium	0.7	Medium high	0.9	0.63
8.1.1. Periodic Activities	Medium low	0.3	Medium	0.7	0.21
8.1.2. Setup	Low	0.1	Medium high	0.9	0.09
8.1.2.1. Contract	Low	0.1	Medium high	0.9	0.09
8.2. Planning & Dispatching	Low	0.1	High	1	0.1
8.3. Order Processing	Medium high	0.9	High	1	0.9
8.3.1. Periodic Activities	Low	0.1	Medium low	0.3	0.03
8.3.2. Setup	Medium low	0.3	Medium	0.7	0.21
8.3.2.1. Status	Low	0.1	Medium	0.7	0.07
8.3.2.2. Pricing	Low	0.1	Medium	0.7	0.07
8.3.2.3. Fault Reporting	Medium low	0.3	Medium	0.7	0.21
8.4. Setup	Medium low	0.3	High	1	0.3
8.4.1. General	Low	0.1	High	1	0.1
9. Human Resources (total complexity)					0.3 + 0.3 = 0.6 UC 0.3 + 0.3 = 0.6 UACF
9. Human Resources	Medium low	0.3	High	1	0.3
9.1. Setup	Medium low	0.3	High	1	0.3
CALCULATED COMPLEXITY OF ERP SOLUTION					**16.5 + 5.1 + 3 + 4.9 + 4.2 + 1.1 + 1.7 + 3.5 + 0.6 = 40.60 UC** **11.82 + 4.42 + 2.73 + 3.94 + 3.74 + 1.01 + 1.49 + 3.01 + 0.6 = 32.76 UACF**

The producer of the observed ERP solution lists seven different business sectors which are covered by ERP solution Microsoft Dynamics NAV 5.0 [5]. Some of these business sectors shown in Table 1 are detailed into several subsectors. For instance, producer of ERP solution Microsoft Dynamics NAV 5.0 mentions business sector "*Consumer packaged goods*", which is in Table 1 detailed into five different business sectors (*22. Apparel and Footwear*, *23. Beverage*, *24. Consumer Durables and Home Appliances*, *25. Food*, and *26. Home and Personal Care*).

By adjusting business sectors supported by ERP solution Microsoft Dynamics NAV 5.0 to the list of supported business sectors shown in Table 1, 12 supported business sectors are obtained. These are: *11. Government*, *19. Chemicals*, *22. Apparel and Footwear*, *23. Beverage*, *24. Consumer Durables and Home Appliances*, *25. Food*, *27. Industrial Machinery & Components*, *29. Electronics Manufacturing Service Providers*, *31. Software Providers*, *32. Industrial Machinery & Components*, *57. Retail* and *70. Wholesale Distribution*. Therefore, the ERP solution Microsoft Dynamics NAV 5.0 covers 12 business sectors which are listed in Table 1.

Some supported business functional areas in ERP solution are common to certain business sectors. [5] Table 5 shows covered business sectors and supported business functional areas which can be applied to the observed sector. The numbers correspond to the following functional areas (see Table 4): *1. Financial Management*, *2. Sales & Marketing*, *3. Purchase*, *4. Warehouse*, *5. Manufacturing*, *6. Jobs*, *7. Resource Planning*, *8. Service*, *9. Human Resources*.

Table 5. Business sectors and business functional areas covered by ERP solution Microsoft Dynamics NAV 5.0

Business Sector	Functional Area							
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
11. Government	✓	✓	✓						✓
19. Chemicals	✓	✓	✓	✓	✓				✓
22. Apparel and Footwear	✓	✓	✓	✓					✓
23. Beverage	✓	✓	✓	✓					✓
24. Consumer Durables and Home Appliances	✓	✓	✓	✓					✓
25. Food	✓	✓	✓	✓					✓
27. Industrial Machinery & Components	✓	✓	✓			✓	✓		✓
29. Electronics Manufacturing Service Providers	✓	✓	✓	✓	✓				✓
31. Software Providers	✓	✓	✓			✓	✓		✓
32. Industrial Machinery & Components	✓	✓	✓	✓	✓				✓

57. Retail	✓	✓	✓	✓			✓	✓
70. Wholesale Distribution	✓	✓	✓	✓				✓

Based on the business functional areas which can be applied in a certain business sector (see Table 5), and based on the complexity of a certain business functional area (see Table 4), it is possible to estimate the complexity of a certain business sector through the complexity of a functional area in ERP solution Microsoft Dynamics NAV 5.0. Table 6 shows the complexity of a certain functional area in unit of measure UACF, and complexity of a certain business sector.

Table 6. Estimation of the complexity of business sectors covered by ERP solution Microsoft Dynamics NAV 5.0 – unit of measure UACF

Business Sector	Complexity of functional area (unit of measure UACF)									Complexity of business sector (unit of measure UACF)
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	
11. Government	11.82	4.42	2.73						0.6	19.57
19. Chemicals	11.82	4.42	2.73	3.94	3.74				0.6	27.25
22. Apparel and Footwear	11.82	4.42	2.73	3.94					0.6	23.51
23. Beverage	11.82	4.42	2.73	3.94					0.6	23.51
24. Consumer Durables and Home Appliances	11.82	4.42	2.73	3.94					0.6	23.51
25. Food	11.82	4.42	2.73	3.94					0.6	23.51
27. Industrial Machinery & Components	11.82	4.42	2.73			1.01	1.49		0.6	22.07
29. Electronics Manufacturing Service Providers	11.82	4.42	2.73	3.94	3.74				0.6	27.25
31. Software Providers	11.82	4.42	2.73			1.01	1.49		0.6	22.07
32. Industrial Machinery & Components	11.82	4.42	2.73	3.94	3.74				0.6	27.25
57. Retail	11.82	4.42	2.73	3.94				3.01	0.6	26.52
70. Wholesale Distribution	11.82	4.42	2.73	3.94					0.6	23.51
Total	**141.84**	**53.04**	**32.76**	**35.46**	**11.22**	**2.02**	**2.98**	**3.01**	**7.2**	**289.53**
									Average	**24.1275**

The estimation of complexity of business sectors covered by ERP solution Microsoft Dynamics NAV 5.0 shows that the average complexity of business sectors is 24.1275 UACF. If this average value is applied to 70 business sectors supported by ERP solutions of various producers, then their total complexity is 24.1276 · 70 = 1688.925 UACF. Table 5 shows functional areas which are present in all 12 business sectors. These functional areas are: *1. Financial Management*, *2. Sales & Marketing*, *3. Purchase*, *9. Human Resources*. This means that a part of complexity is common to all observed business sectors. Since the total amount of this common complexity is 141.84 + 53.04 + 32.76 + 7.2 = 234.84 UACF, and the total complexity of 12 business sectors is 289.53 UACF, this means that 81% of complexity is common in the observed business sectors. Transferred to the complexity of 70 business sectors, it can be estimated that of total complexity which amounts to 1688.925 UACF, 81 % i.e. 1368.029 UACF of complexity is common; in other words, it consists of complexities of same functional areas. Therefore, the remaining 19% of complexity consists of complexities of functional areas which are specific of the observed business sector.

In the previous estimation of the complexity of business sectors supported by ERP solutions, the calculated complexity of functional areas covered by ERP solution Microsoft Dynamics NAV 5.0 was used. Such complexity also considered the importance of functional area in relation to other functional areas. However, it is possible that in two specific business sectors, the same functional area has a different importance (it can be said that in such case the importance of a functional area is determined, among others, by the business sector in which the observed functional area exists). In order to decrease the influence of the business sector on the calculated complexity of the functional area, it is possible to use only the estimated complexity of the functional area (unit of measure UC) in the estimation of the complexity of business sectors. The following table shows the estimation of complexity of business sectors where the estimated importance of the functional area was not taken into consideration.

Table 7. Estimation of the complexity of business sectors covered by ERP solution Microsoft Dynamics NAV 5.0 – unit of measure UC

Business sector	Complexity of functional area (unit of measure UC)									Complexity of business sector (unit of measure UC)
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	
11. Government	16.5	5.1	3						0.6	25.2
19. Chemicals	16.5	5.1	3	4.9	4.2				0.6	34.3
22. Apparel and Footwear	16.5	5.1	3	4.9					0.6	30.1
23. Beverage	16.5	5.1	3	4.9					0.6	30.1
24. Consumer Durables and Home Appliances	16.5	5.1	3	4.9					0.6	30.1
25. Food	16.5	5.1	3	4.9					0.6	30.1
27. Industrial Machinery & Components	16.5	5.1	3			1.1	1.7		0.6	28
29. Electronics Manufacturing Service Providers	16.5	5.1	3	4.9	4.2				0.6	34.3
31. Software Providers	16.5	5.1	3			1.1	1.7		0.6	28
32. Industrial Machinery & Components	16.5	5.1	3	4.9	4.2				0.6	34.3
57. Retail	16.5	5.1	3	4.9				3.5	0.6	33.6
70. Wholesale Distribution	16.5	5.1	3	4.9					0.6	30.1
Total	**198**	**61.2**	**36**	**44.1**	**12.6**	**2.2**	**3.4**	**3.5**	**7.2**	**368.2**
									Average	**30.6833**

Table 7 shows that the average complexity of the business sector, from the perspective of ERP solution Microsoft Dynamics NAV 5.0, where the importance was not taken into consideration, is 30.6833 UC. Applying this average to 70 business sectors results in their total complexity 30.6833 · 70 = 2147.831 UC. Since there are common functional areas for 12 business sectors covered by the observed ERP solution (these are the areas numbered 1, 2, 3 and 9), these functional areas constitute their common complexity. The amount of the common complexity is 198 + 61.2 + 36 + 7.2 = 302.4 UC. Since the total complexity of 12 business sectors is 368.2 UC, this means that 302.4 / 368.2 · 100 = 82.13% is the share of common complexity in the total complexity of the business sector. Transferred to 70 business sectors, 82.13% of their total complexity are common business functional areas, while the remaining share of 17.87% are complexities of functional areas specific of a certain business sector.

5 Conclusion

The paper represents a method for the estimation of complexity of business sectors supported by ERP solutions. The method is based on measuring

complexities of ERP solution, and the list of business sectors which the solution covers.

By applying this method, with using the complexity of the specific ERP solution Microsoft Dynamics NAV 5.0 and the list of business sectors it covers, the total complexity of 70 business sectors was obtained. Further analysis of common functional areas, and their complexities, has shown the existence of a large share in the complexity of a business sector, which consists of functional areas which are common to all analysed business sectors. It can be concluded that the specificities of business sectors form a small share in their complexity.

To determine the share of common and specific elements in the complexity of business sectors covered by ERP solutions more precisely, the estimation of their complexities should be performed though several different ERP solutions.

The presented estimation of the complexity of business sectors is performed through the complexity of ERP solution which was calculated based on the complexity and the importance of their functional areas. The estimation of the complexity of business sectors would be more precise if it would be performed from the complexities of ERP solutions which are calculated based on the complexity and the importance of business activities which are performed within a certain functional area.

The application of complexities of several different ERP solutions in the estimation of the complexity of business sectors would enable an analysis of differences of the complexities of certain ERP solutions. Two questions emerge: do certain ERP solutions have a lower or higher complexity within certain business sectors they cover, and what influences these differences?

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