USING DEPENDENCY STRUCTURE MATRIX IN OPTIMAZING FINANCIAL AUDIT PROCESS

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Abstract: *This paper presents a new approach in evaluating risks of material misstatements in financial audit using dependency structure matrices (DSM). This perspective allows the identification of significant audit risks and can be used by audit managers to optimise resource allocation by focusing on higher risk areas. DSM matrix is widely used in other areas such as industrial production, design engineering and risk management. This approach is not used in financial audit so far. The financial crisis has diminished the activity of the audit clients and has imposed smaller audit fees. The auditors have to optimize their processes in order to maintain the quality of audit, even to improve it for the same audit remuneration. DSM matrix is a solution for this problem. This article points out have to use DSM matrix in financial audit process in order to optimize the allocation of resources, while maintaining audit quality. Our research aims to improve the risk evaluation stage in the financial audit process using DSM matrix to evaluate higher risk areas. We used the Project DSM Tool for representing significant accounts in the Purchase to pay process for a financial audit. Dependencies between accounts were used for creating a DSM matrix that depicts higher risk areas. Also, for each account, several resource allocation parameters such as costs and number of hours to be used for performing audit procedures on that account (from both audit team and client personnel).*
Our research suggests that DSM can provide useful information in detecting risk areas in significant classes of transactions identified in a risk based audit and we recommend using DSM matrix in the planning phase of the audit in order to avoid redundancies in the audit execution phase. This is important considering that the European Commission recommends in the Green Paper for Audit to improve the quality of audits following the setbacks to the profession caused by the financial crisis.

Keywords: audit, risk based approach, DSM matrix, optimizing cost, resources' allocation

JEL classification: M42, M40.

1. Introduction

The audit activity is mainly influence by the time allocated to the audit mission and by the resources optimization. As a fact, when splitting the working time, the audit has to realise their priorities considering the risks that can be associated with financial statements. Disseminating this, Pratt, Jiambalvo, J. (2002) pointed out some elements that are related with the audit team and the performance obtained by it. Their study revealed that resources allocation, the number of tasks that each

audit member has and the time budget are elements that influence overall the audit activity.

Asare,S. Cohen, J., Tompeter, G. (2005) emphasise the importance of audit team qualification, Burke, C. S. & all.(2006) proved that the audit team efficiency is influenced by the managerial personnel resources, by managerial materials and by solving the accounting problems taking into considerations all the risks that are associated with company's financial statements , while Francis, J. R. (2004) demonstrated that information about accounting policies and how they are applied by the audited company is important in the audit examination process. Similar conclusions regarding the performance of audit team were extracted by Scott, T., W., Tiessen, P. (1999) who establishes that the audit activity is influence by their prior targets. As a fact, depending on the mission type and on the resources allocation, there could be realise a comprehensive process of the audited company, of their accounting policies and of how they apply them.

In the main literature, there is a multiple research upon the risk that could be associated with the audit process, evidence about that being pointed out for example by Ohta, Y(2009) and Knechel, W. R (2007) who realises a summary about the business risk audit, its history, evolution, and further perspectives.

In order to reveal the risk encountered in the audit process, there is an important need to detect the areas where the audit should pay higher attention, as there are higher risks associated with it. As a fact, the resources allocation is mainly influence by identifying the potential risk areas in the audit process. Consequently, a proper tool to realize this type of allocation can be the use of dependency structure matrix tool.

DSM matrix is a tool used generally in order to improve the modelling of the system process. As a fact, it can be used for identify groups, for creating packages or for revealing the regions that have similar characteristics. This aspect can be revealed in the audit process in order to identify the areas where the risks are higher, so important financial distresses could be omitted.

The DSM technique was first developed by Steward D. (1967) in order to optimize the product development processes. Further improvements were brought also by the same author in Steward, D. (1981**)** when he applied it for design engineering process. The design structure matrix is one of the most important research methodologies through which the dependencies between the variables encountered are revealed. The idea of using this, is to optimize the relationship between the activities pointed out in the matrix and moreover to obtain a perspective about the planning activity as Pieroni, M (2005) and Manzione. L, Melhado, S. B (2007) proved out. Smith,R. P and Eppinger, S. D(1995) redefined the concept of DSM, while Browing, T. R (2001) reviewed the implementation of Design structure matrix for decomposition and integration problems and emphasis new directions where this model could be applied.

New innovations to this technique were proposed by Banerjee, A. Carrillo, J and Paul, A. (2007) who realized an analysed upon the complexity involved in the algorithms used for constructing the DSM matrix.

Other innovation were proposed by Mori, T. et al(1999), in order to developed proper methodology for optimizing the DSM process. As a fact, the partitioning and tearing algorithms were proper developed. Actually, these two ways of quantifying the algorithms from DSM matrix were propose by Gebala, D.A and Eppinger, S. D (1991). The partitioning algorithm is used for reorganizing the ascending sequence

of the items of the matrix for maximising the availability and the amount of the information that the elements analysed had. On the other hand, the tearing algorithm is based on identifying and reorganizing the blocks of elements that are encountered in the matrix. The idea is to check those elements that could become a package, or that have similar characteristics that have to be taken overall into consideration.
Regarding the DSM matrix, even though it was proved that it brings important efficiency in reducing the total time allocated to the project, the DSM tool has been rarely applied in economic fields. It was mainly used in engineering studies, like Manzione. L, Melhado, S. B (2007) , Pieroni, M (2005), Murphy, G.C., Notkin D., and Sullivan, K.J. (2001), Müller, H. A., Wong, K. and Tilley S. R. (1994).
In order to focus on the perspective of auditors, it is recommended that DSM matrix to be properly applied. As a fact, the time allocated to the audit mission is going to be reduced and moreover a proper resources allocation could be realized. As the financial audit needs additional knowledge to identify the risks associated to audited company, we consider that the DSM tool application can improve sharply the resources allocation. As a fact, the DSM matrix represents the dependencies through which the elements a applying the design structure matrix to system decomposition and integration problems: a review and new directions related, and consequently aspects that are not generally detailed analysed would be encountered in the audit process.

2. Research Methodology

We propose an audit approach based on a new methodology to evaluate risks of audit. This new approach refers to uses graph theory to represent accounts in significant classes of transactions identified using risk based approach. The DSM matrix solves this issue. DSM matrix is based on graph theory, like our assumption. A graph is a model that visually describes elements and relationships between them. The components of a graph are: vertices (nodes) and edges. Nodes may or may not have a weight and the edges may or may not have directions and/or costs. Graphs may be represented using adjacency matrix which is a n by n matrix (n = number of vertices in the graph) with elements ai,j that may be 0 (if there is no edge from i to j) or 1 (if there is an edge between i and j).

Please refer to Figure 1 for graph example and to Table 1 for the adjacency matrix representing it.

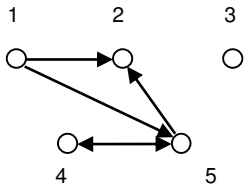


Figure 1: Graph example
Source: Authors projection

Table 1: Adjacency matrix

	1	2	3	4	5
1	1	1	0	0	1
2	0	1	0	0	0
3	0	0	1	0	0
4	0	0	0	1	1
5	0	1	0	1	1

Source: Authors projection

The authors used the Project DSM Tool to depict the significant accounts in the purchase to pay class of transactions. In a typical audit the main accounts to be considered for this class of transactions are as follows:

- Inventories;
- Property, plant and equipment;
- Advances to suppliers;
- Admin expenses;
- Commercial expenses;
- Production expenses;
- Discounts;
- Accounts payable;
- Cash and bank

Please refer to Figure 2 for the representation of accounts that impact the risk of significant misstatement for the purchase to pay class of transactions.

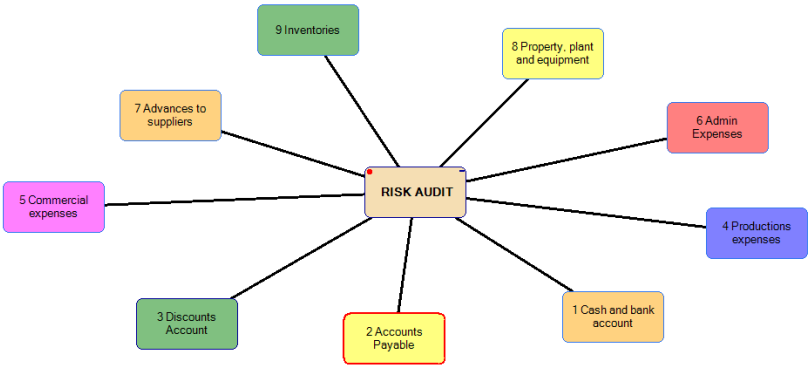


Figure 2: Representation of accounts and audit risk
Source: Author export from Project DSM Tool.

We established the dependencies between significant accounts in the Project DSM Tool based on the following rationale:

- The inventories account relates to Accounts payable, Production expenses and Advances to suppliers accounts;
- The Property, plant and equipment account relates to the Accounts payable account;
- The Advances to suppliers account relates to Accounts payable, Cash and bank, Inventories and Discounts accounts;
- The Admin expenses accounts relates to the Accounts payable account;
- The Commercial expenses account relates to the Accounts payable, Advances to suppliers and production expenses accounts;
- The Production expenses account relates to the Accounts payable, Commercial expenses and Inventories accounts;
- The Discounts account relates to Accounts payable, Cash and bank and Advances to suppliers accounts.
- The Cash and bank account relates to Accounts payable and Discounts accounts;
- The Accounts payable account relates to all accounts above.

Please refer to Figure 3 for the dependencies map, as described above:

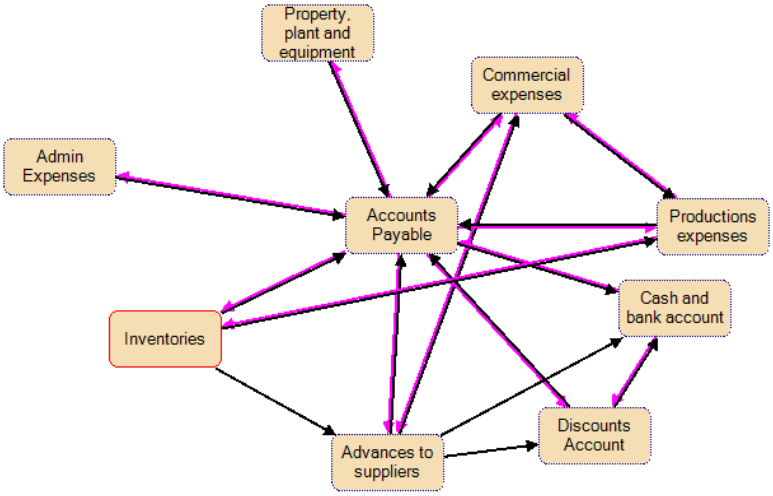


Figure 3: Accounts dependencies in the Purchase to pay process
Source: export from Project DSM Tool

Please refer to Figure 4 or the Project DSM Tool menu for defining dependencies between accounts.

Components	Strength	
System: RISK AUDIT		
2 Accounts Payable	Dependent	None
3 Discounts Account	Dependent	None
4 Productions expenses	Dependent	None
5 Commercial expenses	Dependent	None
6 Admin Expenses	Dependent	None
7 Advances to suppliers	Dependent	None
8 Property, plant and equipment	Dependent	None
9 Inventories	Dependent	None

Figure 4: Defining dependencies for the Cash and bank account
Source: export from Project DSM Tool

For each account we allocated a standard number of hours and cost, considering a typical audit engagement. For instance, for the Cash and bank account, we considered 20 hours for audit team members and an additional 8 hours needed from client personnel (for audit support purposes). Also, a cost of 3000 RON was considered based on hourly rates for audit senior and junior staff.
Please refer to Figure 5 for the defined resources in the Project DSM Tool

ID	Name	Effort (H...
1	Cash and bank account	28,0
2	Accounts Payable	48,0
3	Discounts Account	28,0
4	Productions expenses	68,0
5	Commercial expenses	48,0
6	Admin Expenses	48,0
7	Advances to suppliers	48,0
8	Property, plant and equipment	48,0
9	Inventories	68,0

ID	Name	Total Cost
1	Cash and bank account	5000
2	Accounts Payable	3000
3	Discounts Account	3000
4	Productions expenses	8000
5	Commercial expenses	8000
6	Admin Expenses	5000
7	Advances to suppliers	5000
8	Property, plant and equipment	5000
9	Inventories	8000

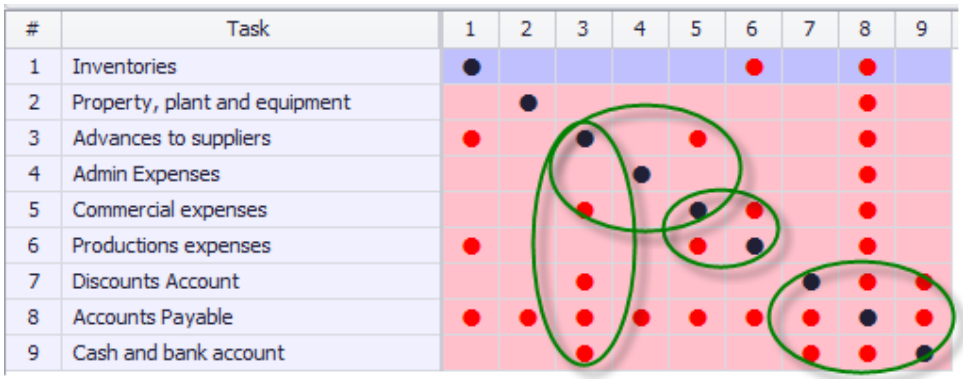
Figure 5: Defining resources in the Project DSM Tool
Source: export from Project DSM Tool

3. Results and discussion

Based on the data input above, we obtained the following results in the Project DSM Tool:

- DSM matrix;
- Combined resource allocation assessments;

The DSM matrix shows the areas with potential high risk of material misstatements based on dependencies between account classes as described in the previous section. We noticed four areas with potential higher risk that should be considered when planning the audit procedures. The areas where audit managers should focus their tests are depicted in Figure 6.



#	Task	1	2	3	4	5	6	7	8	9
1	Inventories									
2	Property, plant and equipment									
3	Advances to suppliers									
4	Admin Expenses									
5	Commercial expenses									
6	Productions expenses									
7	Discounts Account									
8	Accounts Payable									
9	Cash and bank account									

Figure 6: DSM Matrix
Source: export from the Project DSM Tool

In the first stage of the analysis, as per the DSM matrix results, auditors should consider for testing the following account pairings:

- Discounts - Accounts payable - Cash and bank account
- Commercial expenses – Production expenses
- Advances to suppliers – Commercial expenses – Discounts – Accounts payable – Cash and bank account
- Admin expenses – Commercial expenses

The Accounts payable should be considered for further testing as it is related to all accounts in the Purchase to pay process.
In the second stage of the analysis, auditors may conclude that two of the areas, Commercial expenses – Production expenses and Admin expenses – Commercial expenses, do not contain risks of material misstatements and should not be further tested.

The combined resource allocation table shows the total allocated resources (audit hours and costs) considering the dependencies described in the previous section and a rework percentage of 10-20% (i.e. up to 20% of the work performed by auditors will have to be re-performed following reviews from the audit managers).
Please refer to Figure 7 for the allocation table as per the Project DSM tool.

Option N...	Score	Action	Complexity	Cost	Effort
Perform	10	Simplify: Admin Expenses depends on Accounts Payable	21,0	8,9	9,8
Perform	10	Simplify: Accounts Payable depends on Admin Expenses	21,0	8,9	9,8
Perform	10	Delay element 6: Admin Expenses	21,0	8,9	9,8
Perform	10	Promote element 6: Admin Expenses	21,0	8,9	9,8
Perform	7	Promote element 9: Inventories	21,0	14,3	13,9
Perform	7	Delay element 2: Accounts Payable	80,2	48,2	52,5
Perform	7	Promote element 2: Accounts Payable	80,2	48,2	52,5
Perform	6	Delay element 3: Discounts Account	21,0	10,7	11,5
Perform	6	Delay element 1: Cash and bank account	21,0	17,9	11,5

Figure 7: Combined resource allocation
Source: export from the Project DSM Tool

Based on the output from the Project DSM Tool we observe that the most complex elements are Accounts payable, the same account that we observe from DSM matrix.
From this analysis we observe that the Accounts payable are the most significant element and the risks are concentrated in this area.
This type of analysis can help the management team to choose the most efficient allocation of resource while covering all significant risks of misstatement.

4 Conclusion

Evaluating audit risk is one of the main challenges in the audit process especially when using a risk based approach. Auditors have to find a balance between the allocated resources and the assurance obtained from performing audit procedures considering the costs. The financial crisis had a significant impact on audit fees, with audit firms constantly having to reduce costs while maintaining audit quality. Even in the Green Paper for Audit the European Commission recommends having high quality financial audits because the sustainability of this profession is doubtful.
The current approach on financial audit must be reconsidered in order to provide creditworthiness for the audit opinion.
Our research aims to improve the risk evaluation stage in the financial audit process using DSM matrix to evaluate higher risk areas. Based on this evaluation audit managers can better allocate resources to cover these areas and thus to optimize the audit process while maintaining audit quality.
As shown in this paper, DSM can provide useful information in detecting risk areas in significant classes of transactions identified in a risk based audit.
We recommend using DSM matrix in the planning phase of the audit in order to avoid redundancies in the audit execution phase.
The main limitation of our research is the lack or real life audit data. In order to obtain real audit data, inside information is needed and the confidentiality principle of audit does not allow auditors to disclose such information.
Our plan is to develop our research by applying DSM matrix to an audit engagement and to compare the results in detecting risk between the classic audit approach and the DSM approach. When the model would be implemented into practice will be able to analyse the gain in audit quality made by this new methodology.

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