Harnessing ISM for Customer Churn Management in Mobile Telecommunications Networks

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Abstract: Customer attrition in the mobile telecommunications industry poses a multifaceted and expensive challenge, frequently associated with the intricate relationships among subscribers, services, products, and personnel. The churn issue can significantly affect service providers profitability and competitive advantage, requiring a strategic and innovative approach for effective management. This study presents an innovative method of employing Interpretive Structural Modeling (ISM) to manage attrition strategically. The study commences with a comprehensive examination of conventional qualitative techniques employed in churn management, specifically Causal Loop Diagrams (CLD) and Relationship Diagrams (RD). This assessment underscores the advantages and drawbacks of these traditional methods. By outlining fundamental criteria for their critical evaluation, we enhance our comprehension of how they can proficiently tackle the intricate problem of customer attrition. The study subsequently provides a comprehensive exposition of the Interpretive Structural Modeling (ISM) methodology, elucidating each phase of the process and highlighting the fundamental principles that underpin strategic decision-making. This methodology systematically analyzes churn dynamics, emphasizing the complex relationships among customer attrition factors. The primary objective of the ISM model is to facilitate proactive decision-making by pinpointing critical levers that can mitigate customer attrition. Particular emphasis is placed on the pivotal variables in these dynamics, facilitating targeted interventions with a direct and quantifiable effect. Finally, a comprehensive comparison is conducted between the ISM approach and conventional methods such as CLD. This comparison offers strategic insights by highlighting ISM's strengths in the competitive telecommunications industry. Compared to conventional methods, the ISM is more advanced and more suited to providing proper solutions to various problems associated with churn management, demonstrating its ability to aid in customer retention.

Key-Words: Customer Churn, Interpretive structural modeling, Mobile telecommunication networks, Qualitative modeling, and Decision support.

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1 Introduction

1.1 Background and Motivation

Customer attrition, known as Churn, has been a major threat to mobile telecommunication service providers. In such a market, it is cheaper and more essential for the business to retain clients in the long run, [1]. To this end, it has been advocated that Causal Loop Diagrams (CLD) and Relationship Diagrams (RD) be used. However, these methodologies usually have to accommodate the entire breadth of the parameters that cause churn, [2], [3]. However, the interrelation of these parameters is complex and makes strategizing quite difficult. That said, ISM allows for focusing on what would have otherwise been considered irrelevant variables. Accompanying ISM is a specific, organized approach towards determining and ranking various elements interrelationships, providing measures that can reduce Churn in absolute terms. This paper explores the ISM approach to explore effective churn management mechanisms. This method offers innovative and adaptive solutions for telecommunications operators to increase customer retention in a rapidly competitive environment.

1.2 Problem Statement and Research Objectives

Churn poses a vital problem for mobile telecommunications operators since it significantly impacts their profitability and competitiveness.

The relationship between customer satisfaction, quality of service provision, and the competition mix of offers is complex, making it hard to develop effective turnover strategies, [4]. This paper aims to assess churn resignation management approaches as qualitative analysis as applicable in real life and provide suitable ways for evaluating them. This study will provide an in-depth background of the use of the ISM methodology concerning the various phases contributing to the aforementioned strategic decision-making. The ISM approach will be implemented on a mobile telecommunication system to build and study a digraph depicting the complex relationships of factors and parameters affecting Churn. In undertaking this analysis, the main focus will be on the relationships among those factors to determine the determinant factors. The models presented above are based on ISM. A comparative analysis will be done on the effectiveness of ISM and other approaches, including CLD. This comparison intends to provide strategic advice and practical measures designed to enhance client loyalty in relation to competition.

1.3 General Strategies to Tackle Each of the Objectives

This study aims to utilize traditional qualitative methods aimed at the problem of customer attrition with particular emphasis on Causal Loop Diagrams (CLD) and Relationship Diagrams (RD). This conceptualization will be more critical by looking at the pros and cons of those methods. Although CLD and RD help to understand the broader picture of Churn, they tend to represent something other than the multifaceted nature of customer loss, which consists of numerous interacting elements. By scrutinizing their limitations, we can more effectively recognize the deficiencies of these methods and identify the necessity for more sophisticated tools. Following this assessment, we will comprehensively elucidate the Interpretive Structural Modeling (ISM) methodology. This section will delineate the complete ISM process, encompassing model construction, result interpretation, and the subsequent application of these insights to strategic decision-making. We will include practical examples at each stage to elucidate how ISM effectively delineates and examines the intricate relationships influencing customer churn, thereby facilitating the identification of critical factors requiring attention.

The ISM methodology will be implemented explicitly in the telecommunications sector to identify key levers for mitigating Churn. By examining how ISM elucidates the interactions among various factors, we can formulate more precise, targeted strategies that directly tackle customer retention challenges. A comparison between ISM and conventional methods such as CLD will ultimately be made. This analysis examines the available approaches for moderating Churn. It explains why ISM is better as it provides broader and more insights on churn behavior being beneficial to operators wanting to remain competitive.

1.4 Comprehensive Summary of the Core Findings

The research highlights an important aspect: While Causal Loop Diagrams (CLD) or Relationship Diagrams (RD) can serve as the fundamentals for the first stages of studies, they tend to do so at the expense of capturing the entire complexity of customer attrition within the mobile telecommunications industry. However, these constraints apply to other approaches, especially common ones, in diving into complex reasons explaining the loss of clients to the competition. In contrast, Interpretive Structural Modeling (ISM) is a powerful technique for comprehensively addressing the issue of Churn. ISM allows the concentration and the picturing of strategic pivots, which are important in increasing chances of reducing the rates of being ‘lost’ or ‘churned.’ ISM achieves this multidimensional perspective of the phenomenon of Churn by examining the relationships among all the potential factors that may contribute to the loss of clients. Traditional techniques are not as organized and methodical as ISM in determining the probable issues that may lead to losing customers for a particular entity. This research applies ISM so that it can formulate specific and feasible suggestions aimed at minimizing Churn. The appropriateness of ISM in performing churn management activities at the strategic level is apparent; it complements traditional techniques and achieves a better comprehension of the essence of the problem of customer departure. This integrated methodology enhances the accuracy of churn forecasts and improves the quality of decision-making. As a result, ISM proves to be an invaluable tool for improving customer retention strategies in an increasingly competitive market.

1.5 Overview of the Paper Structure

The paper examines ISM for managing Churn. Section 2 critiques traditional methods. Section 3 explains the ISM methodology. Section 4 applies ISM to a churn model in telecommunications. Section 5 identifies strategic levers. Section 6 compares ISM to traditional methods. Section 7 summarizes the findings and practical implications and suggests avenues for future research.

2 Critical Evaluation and Identification of Limitations of Traditional Qualitative Methods

Traditional qualitative methods, such as Causal Loop Diagrams (CLD) and Relationship Diagrams (RD), will first be presented, followed by an evaluation of their strengths and limitations.

2.1 Inventory and Explanation of Some Traditional Qualitative Methods

Various qualitative methods exist for analyzing and understanding the factors influencing complex systems. Among these are Causal Loop Diagrams (CLD) and Relationship Diagrams (RD), [2], [3]. CLDs graphically represent causal relationships between different variables; see Figure 1, [5]. They are used to identify feedback loops and complex dynamics within a system. They help to understand how changes in one variable can influence other variables and ultimately alter the system's overall behavior. RDs illustrate interactions among various system elements, facilitating the visualization of connections between different factors; see Figure 2, [6]. They allow for analyzing the interactions and links among variables, thus comprehending the system's dynamic behavior in great detail.

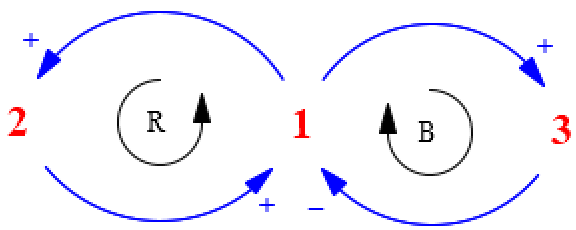

Figure 1: Illustrative structure of a CLD model.

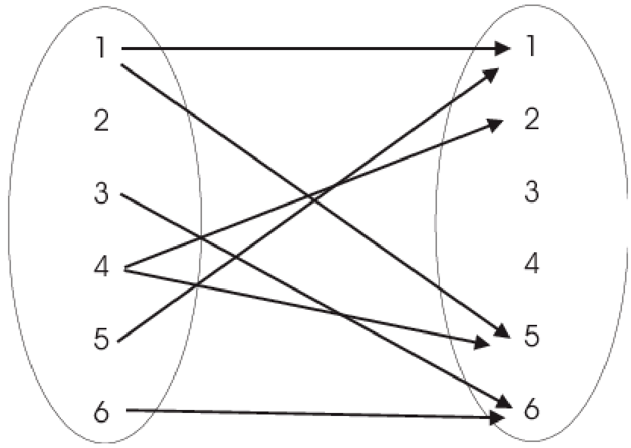

Figure 2: Illustrative structure of a DR model.

2.2 Evaluating Traditional Methods: A Comparative Analysis

Conventional techniques require assessing their capacity to link different factors, [5]. What is more, these methods have to be simple, flexible, and able to explain intricate relationships in a manner that makes it easier for the target audience, [3]. On the other hand, these methods must undergo a realism check to help produce dependable answers to the problems posed within many contexts, [6]. This evaluation determines measures that help overcome adequate decision-making in churn management systems.

2.3 Exploring the Limitations of Traditional Churn Management Methods and the Advantages of the ISM Approach in Addressing These Challenges

Inter-relationships and causal relations, including customer churn, can be modeled using Causal Loop Diagrams (CLDs) and Relationship Diagrams (RDs). However, applying them also has limitations, such as the temporal aspects of the phenomena needing adequate attention. Given such a general focus on relationships, CLDs and RDs overlook the meaningful time-dependent relationships of an event with other events or activities that evolve. On the contrary, ISM offers the application of a directed graph or Digraph to organize and develop the model's components, which is more accessible and better. This methodology provides a much clearer and better way to depict the relationships between the factors affecting Churn. The systematic mapping of these relations enhances the knowledge of the nature of the interrelationships and the influence among the various elements.

Further, because ISM graphically depicts the structure of these relationships and the order in which they occur, it allows the formulation of strategies that target the key factors to decrease customer winback. This straightforward approach defines the main factors that lead to the loss of customers and allows for formulating methods that could be practical in decision-making. ISM expands the boundaries of why customers leave the business to include equally essential causes that contrast traditional approaches. The reasons for this deduction about the arguments of this study are summed up in Table 1.

Table 1: Summary of Traditional Churn Management Methods, their Limitations, and the Complementary Advantages of ISM.

Limitations of Traditional Methods	Advantages of ISM
Causal Loop Diagrams (CLDs) and Diagrams of Relationships (DRs) can get convoluted when dealing with complex dynamic systems, making them difficult to interpret. They often ignore the relationship linkages as time dynamics and feedback do, which decreases their utility when looking at customer churn.	This technique organizes variables into a directed graph, thereby explaining interrelationships and ultimately enabling the analysis of complex systems. It includes feedback on the most critical parts, enhancing our system comprehension. Besides, it also presents a different perspective on the issue of time dynamics that helps understand how changes take place over time.

3 Brief Overview of Interpretive Structural Modeling (ISM)

This section outlines the principles of Interpretive Structural Modeling (ISM). The paper specifies how an ISM model is constructed and enables learning to promote sound decisions based on the results.

3.1 Brief Definition and Importance of the ISM Methodology

Interpretive Structural Modeling (ISM) is a method specifically intended to analyze multilevel complex systems by making the relationships and influences among different sets of variables unambiguous. The main benefit of ISM is that it allows for separating complex issues into manageable parts while reasonably linking them into a consistent hierarchical order. This is more critical when addressing the various customer churn problems in the telecommunication industry. ISM helps depict the interactions of Churn and assists in establishing the interrelations of various factors. Such analysis is important in establishing appropriately targeted key leverage points for maximum effectiveness in reducing churn rates.

The ISM hierarchical structure assists in understanding the variation in customer retention by determining the most important factors that inhibit its achievement. From this viewpoint, it is possible to diagnose the reasons for churn tendencies and enable strategic decision-makers to formulate and adopt decisive measures. ISM provides the organization's customers with comprehensive knowledge of how the organization operates, which is important in formulating appropriate strategies to mitigate customer losses. The application of ISM makes it possible for organizations to take a policy stance on the management of Churn, managing and enhancing other factors to increase retention and overall organizational effectiveness in the market, [7].

3.2 Building an ISM Model for a Complex System

In order to build an efficient ISM model, it is necessary to have a step-by-step plan that considers the multiplicity of interactions within the system. It starts by establishing all relevant variables, including all the influencing factors and the factors that have been measured. This step is crucial since it guarantees a full appreciation of the problem.

Considering the identified variables, the other stage is to define their relationships within the context. This step requires deeply scrutinizing the cause-effect linkages, dependencies, and feedback to define the variables' scope. The Structural Self Interactions Matrix (SSIM) is a vital phase component. This tool is essential as it defines the interrelationship and shows how one variable affects others. The SSIM allows for the presentation of the relationships in the figure, which improves the understanding of the system's dynamics from various perspectives.

Another step in building SSIM is converting to the Reachability Matrix (RM). This matrix explains how a particular variable can reach one or more variables through one or more pathways. Knowing such pathways is important to monitor the system's flows.

Reachability Matrices can be classified into two distinct categories: the Initial RM, which records only the direct paths of influence, and the Final RM, which encompasses both direct and indirect paths. For insights into concepts covered in RMs, final or Complete Reachability Matrices apply an absolute definition and provide telescoping or overlapping inclusiveness of all relationship occurrences, [7], [8].

Once the RM has been established, the next task is level partitioning, which consists of a process that divides variables into different levels of a hierarchy depending on their susceptibility or dominance. Such division is of great help in explaining the place of a variable in terms of its level of influence and role in the functioning of a particular system, [9]. The Cone Matrix makes Such a depiction possible, enabling the influence cones to be plotted to indicate the distribution and relation of the different variables in the hierarchy of levels.

After the level partitioning phase, the Cone Matrix forms part of the mesh structure from which a directed graph (Digraph) is derived. This Digraph arranges the variables in the mesh according to hierarchy levels and shows only the direct relationships between the variables arranged according to the hierarchy.

This method shows how influence flows and connects, which is important for analyzing the system's dynamics, [9], [10]. From the analysis of the Digraph, leverage points can be identified, actions can be prioritized, feedback loops can be recognized, and therefore, indispensable perspectives of the core forces and mechanisms in the system are provided, [11].

The final step involves directing decision-making through strategic recommendations derived from the above-mentioned comprehensive exercise. This involves identifying critical variables for targeting, analyzing the long-term consequences of interactions, classifying variables and actions based on their potential impact on Churn, evaluating the cumulative effects of these interactions, and prioritizing actions according to their significance and identified leverage points. By implementing this strategic and coordinated methodology, organizations can more effectively manage customer attrition while being guided by a comprehensive understanding of the system's dynamics.

4 Complete Application of ISM to the Case of Churn Management in a Mobile Telecommunications System

4.1 Inspiration Context of this Study

The mobile telecommunications market in Africa is characterized by intense competition and substantial profitability. The sector is marked by numerous providers competing vigorously in each country, making it a highly dynamic and lucrative industry. For context, we draw our initial insights from the telecommunications landscape in Zambia, which mirrors the competitive conditions in other African nations, such as the Democratic Republic of Congo.

In Zambia, the entry of major players like ZAMTEL, MTN Zambia, and Airtel Zambia has catalyzed substantial growth within the telecommunications sector. This competitive environment has driven significant expansion in subscriber numbers and market penetration. For instance, by 2015, Zambia had achieved a notable subscriber base of 10.8 million, translating to a penetration rate of 70%, [12]. This growth trajectory reflects broader trends observed across similar African markets, where competition and market dynamics continue to shape the telecommunications landscape.

4.2 Application of the ISM Methodology in Churn Management

4.2.1 Step 1 – Identification of Variables

We present Figure 3, which illustrates each variable with an ID to facilitate a good reference to each variable and the various analysis steps within the ISM methodology framework.

Part 1

Id	Variables
1	Population
2	Births
3	Deaths
4	Population subscribed to mobile services
5	Mobile penetration rate
6	Operator's customers at the beginning of the year
7	Annual churn rate
8	Churners during the year
9	New customers acquired during the year
10	Operator's customers at the end of the year
11	Competitors' reaction
12	Customer service improvement
13	Acquisition and training of staff on products
14	Staff training on customer service delivery and
15	Service cost reduction
16	Network quality improvement
17	Network coverage increase
18	Investment in new technologies
19	Improvement of store and office convenience
20	Enhancement of brand and product visibility
21	Stocking trendy phones in stores
22	Responding to competitor initiatives
23	Billing error
24	Promotional gifts
25	Segmented customer management
26	Customer lifecycle management
27	Churn and social media campaigns
28	Follow-up with potential unsubscribed customers

Part 2

29	Special offers for potential churners
30	Unreliable customer service line
31	Customer loyalty programs
32	Resolution of billing errors – lost items
33	Poor customer service
34	Incompetent employees
35	Poor problem resolution
36	Rude customer service
37	Poor network quality
38	Poor network coverage
39	Lack of technology
40	Office and store location
41	Poor product availability
42	Lack of trendy phones
43	High service costs
44	Competitor offers
45	Customer needs not being met
46	Unsolicited messages and others
47	Not feeling appreciated
48	External factors (e.g., income, employment
49	Potential churners
50	Customers who canceled their termination
51	Operator's market share
52	Current churners (Customers actually
53	Customer acquisition rate
54	Birth rate
55	Death rate

Figure 3: Identification of the System Variables

4.2.2 Step 2 - The relationship between variables in the context

See Figure 4 for the relationships between variables, [12].

Part 1

Variables	List of variables it influences	List of variables that influence it
1	2,3,4	2
2	1	1,54
3	1	1,55
4	6,9,11,48	1,5
5	4	-
6	8,7,10	4,9,51
7	-	6,52
8	52,49	6
9	10,6	4,53
10	-	6,9,52
11	50	4
12	50	30,33
13	50	34,35
14	50	36
15	50	43
16	50	37
17	50	37,38
18	50	39
19	50	40
20	50	41
21	50	42
22	50	44
23	32	49
24	50	43,44
25	50	45
26	50	45
27	50	45,47
28	50	45,46,47

Part 2

29	50	45,47
30	12	49
31	50	47
32	50	23
33	12	49
34	13	49
35	13	49
36	14	49
37	16,17	49
38	17	49
39	18	49
40	19	49
41	20	49
42	21	49
43	15,24	49
44	24,22	49
45	25,26, 27,28,29	49
46	28	49
47	27,28,29,31	49
48	50	4
49	23,30,33,34,35,36,37,38,39, 40,41,42,43,44,45,46,47	8
50	52	11,12,13,14,15,16,17,18,19,20, 21,22,24,25,26,27,28,29,31,32,
51	6	-
52	7,1	8,5
53	9	-
54	2	-
55	3	-

Figure 4: Direct Influence Relationship Between Variables

4.2.3 Step 3 –- Development of the Structural Self-Interaction Matrix (SSIM)

The Structural Self-Interaction Matrix (SSIM) is an integral method for analyzing the effects of churn management in a competitive environment. The construction of this matrix elucidates the interrelationships among various factors affecting customer attrition. The Structured Self Interaction Matrix (SSIM) is an integral tool in the research for establishing and classifying the relationships between variables. The framework is based on self-interaction models and, therefore, shows the broader perspective underlying the specific variables as concepts and the system as a whole, [7]. This type of understanding is very helpful in designing the interaction and the dynamics of the problem. The SSIM is given in Figure 5 (Appendix). In this context, every matrix cell represents a connection or interaction between two variables (i and j) regarding churn management. The various interactions are said to be influenced in four manners: V, A, X, and O, which indicates how the various variables influence each other. V (i influences j) means j is directly affected by variable i. A (j influences i) means j primarily influences i; that is, the variable j affects the influence of i. X shows that the relationship is a two-way or reciprocal whereby i and j variables affect each other. O indicates a lack of direct interaction between the variables i and j.

The SSIM is instrumental in providing a systematic means of discovering and modeling intricate relationships in a system. It is important to note that the interaction with such structures provides an avenue for greater levels of mechanistic reasoning. The SSIM is not merely representational but also serves practical purposes, such as enabling visualization of the complex web of relations relevant to churn management. This is performed in cases after developing the SSIM; the next stage is transforming it to the Reachability Matrix RM. The RM also extends the SSIM by introducing the concept of direct and indirect relations. This advancement enhances analytical capabilities by showing how some variables are related directly and indirectly, thus providing a basis for developing sophisticated models and better decision-making, [7]. By doing so, this systematic approach also helps ensure that all the relevant relations are included and the points in the system with high potential for strategic change are quickly located. As such, the SSIM and RM will be important tools in this study stage to help pinpoint the variables most capable of reducing the churn rate and enhancing the retention mechanisms.

4.2.4 Step 4 – Conversion to the Reachability Matrix (RM):

Understanding the influence dynamics within the system is imperative, and this understanding will be made possible when the Structural Self-Interaction Matrix (SSIM) is changed to the Reachability Matrix (RM). This considers the hierarchy of causes and effects of the variables, which is essential in locating key leverage positions in churn management. The Initial Reachability Matrix (RM), illustrated in Figure 6 (Appendix), is produced by methodically transforming the SSIM values. In this procedure, if variable i directly affects variable j (indicated by a “V” in the SSIM), it is assigned a value of 1 in the RM. If j is such that it influences i (indicated by “A”), then 0 should be recorded.

Mutual influences, represented by “X,” are assigned a value of 1, indicating the reciprocal relationship between entities i and j. When there is no direct interaction between variables, as indicated by an “O” in the SSIM, a value of 0 is assigned in the RM. Implementing these transformations results in the matrix configuration shown in Figure 6 (Appendix), illustrating the direct relationships among the variables, [7], [11]. The Initial RM highlights the importance of direct interactions; however, a thorough understanding of the system requires acknowledging the indirect influences among variables. The Final Reachability Matrix, illustrated in Figure 7 (Appendix), is derived from the Initial RM by applying the transitivity principle. During this phase, the matrix value is adjusted when variable i influences variable k through an intermediary variable j. A zero is replaced by a 1*, with the asterisk indicating an indirect influence. Direct influences are indicated by a value of 1. Incorporating transitivity in the Final Reachability Matrix (RM) enhances understanding of the system's dynamics by accounting for direct and indirect influence pathways. This matrix illustrates the significant influence of seemingly unrelated variables on each other via intermediary factors.

Thus, the Final RM improves insights into constructing the strategic understanding of customer loss in the telecom industry. In doing so, decision-makers can focus their efforts and plan purposeful actions dealing with customer churn. This matrix is used to further count levels and other metrics, like level partitioning and formation of the Digraph, [7], [11]. Analysis of the final RM Matrix is illustrated in Figure 8 (Appendix). We have changed the 1* in the 7 with 1. The number one star and one both contribute.

4.2.5 Step 5 – Level Partitioning:

A crucial step in the second stage of LSP is the classification of variables into a hierarchical structure according to their importance and reliance within the system. This process deepens the comprehension of the importance of each variable in the dynamics of churn management, especially in determining the relative importance of the variables at different levels. Scaling starts with estimating reachability and antecedent sets associated with each variable. The reachability set includes all variables that the specified variable can affect directly or indirectly. On the other hand, the antecedent set comprises all variables capable of affecting the specified variable. These sets are formulated from the Final Reachability Matrix (RM) by examining certain columns and rows containing one. After defining both sets, an intersection of the two sets is first obtained and represented as I. This intersection is important in establishing the rank of the hierarchy of all the variables in the system. If the intersection i corresponds with the reachability set of a variable, that variable resides at the apex of the hierarchy, signifying its predominant influence over others. Once this is done, it is ruled out of consideration, and the activity continues with the other variables. In the case of inconsistent intersections, the two important indices used are Driving Power, interpreted as active or the number of variables activated by a variable, and Dependence Power, which denotes the number of variables that activate that variable. The variables that possess high dependence power are usually in the highest labor grade, and if there are equivalently high values for MP, then driving Power is used as a secondary criterion to distinguish them. This hierarchy makes it easier to show the competing influences of the components of the model of the churning process and to make that conceptualization more explicit to work out determinants and anti-determinants of the system, [7], [10], [11], [13]. Concentrating on these major aspects helps companies address chance theft and retention activities in a more focused manner.

We systematically describe the levels in which variables belong, giving the relationship structure that shows the level of dependence and independence directly and indirectly within the system. This framework is particularly useful for management, as it identifies the components of averaging that do not need a higher degree of attention in change processes and what effects changes on one level have on others.

Figure 9 (Appendix) shows the actual behavioral process of partitioning boundaries between variables depending on their reachability and dependence attributes. Such a hierarchical model allows for a more organized method of dealing with Churn by concentrating on a few leverage points within the system. A total of 22 levels of hierarchy have been established for the churn management system.

Variables 7 and 10 are at the highest level (level I). In contrast, variables 54 and 55 are located at the lowest level (level 22), as illustrated in Figure 9 (Appendix). This clear organization facilitates strategic planning and improves our comprehension of system interactions, ultimately promoting more effective churn management strategies.

4.2.6 Step 6 – Cone Matrix:

The Cone Matrix is an essential visualization instrument that elucidates the hierarchical framework of the system, as established in the prior phase of level partitioning. It offers a distinct representation of the hierarchical arrangement of each variable according to the identified levels, enhancing comprehension of the system's internal dynamics and the influence flow between levels. Figure 10 (Appendix) illustrates the Cone Matrix, which categorizes the variables based on their hierarchical levels.

The levels are established by arranging the Final Reachability Matrix (RM) rows by the hierarchical partitioning illustrated in Figure 9 (Appendix). In our hierarchical framework, the lower tiers are occupied by variables exhibiting the highest dependence. In contrast, those with greater driving force and reduced dependence are positioned at the apex. This configuration effectively demonstrates how subordinate variables affect their superior counterparts, lucidly depicting the system's dynamics.

The Cone Matrix is important in gaining insight into the system as a whole. Arranging variables in a cone structure helps decision-makers identify leverage points and other key drivers that significantly affect different levels. This systematized method assists in accomplishing the objective by focusing on the most critical variables.

Moreover, Figure 11 (Appendix) expands the number of variables of the system, giving an elaborate classification of them.

This classification aids comprehension by organizing variables according to defined features, such as influence or dependence, degree of interaction, and importance. This description provides a summary of the relationships and effects that exist between the variables. This matrix approach of describing the churn behavior of telecommunication subscribers provides a solution that easily identifies the key variables, how they relate to each other, and decision-making in the context of churn management and customer retention.

In a system, independent variables are the most important as they influence the dependent variables while bearing the least influence from them. This outline is critical in focusing on the processes or decision-making as it describes the factors or influences that cause changes or influence the outcomes. Dependent factors receive much of their influence from external changes and are considered outputs of the given system. Although these variables are critical in analyzing systems due to their refined ability to change, they have a minimal effect on other variables.

Concerning the scope of interaction with other factors, external variables rely on autonomous factors and provide minimal touch to the system. Their sense of stability is relatively high and, as such, does not interfere with the general changes within a system. Linking variables are essential in this description as they are affected and actively interact with other factors. This dual role assigns them the dissection role of the system's comprehensive framework of interrelationships and feedback loops, [7].

The categorization of variables into independent, dependent, autonomous, or linking can provide a vital interpretation of the behavior of the system. This, in turn, helps the decision-makers determine the strategic issues and define the aspects where the focus of intervention needs to be directed to maximize the effect. Understanding these perspectives increases the effectiveness of designing and implementing strategies in relation to the key leverage elements of the system.

4.2.7 Step 7 – Digraph:

A more precise concept of relationships between system elements is conveyed with a directed graph or a digraph. In this case, nodes depict the elements, and directed edges (arrows) display their relationship with one another. The general view of the system is depicted in Figure 12 (Appendix), considering the links among all the variables concerning their levels. Although variables are instances in the model, arrows indicate the variables that are directly related to each other. This layout explains how one variable affects another and specifies the overall direction of influence within the system. Understanding this visual configuration assists decision-makers in appreciating the complex interactions involved and devising effective strategies for effective churn management.

This Digraph delineates each variable's direct relationships and hierarchical positioning in the level partitioning phase. The Digraph elucidates the system's structure by visualizing relationships, enabling the identification of critical leverage points and potential feedback loops. It is an essential instrument for examining how alterations in one variable can disseminate throughout the system and influence other variables, facilitating more informed and strategic decision-making.

4.3 Interpretation of the Digraph obtained after ISM Application

We have 22 levels, ranging from the most dependent to the most influential. The factors at the highest level of the hierarchy are 7 and 10. The factors at the lowest level of the hierarchy are 54 and 55.

Regarding the analysis of connections, Figure 12 (Appendix) shows each variable's various direct and indirect influences. The "Base Factors" (i.e., Levels 19 to 22) are 54, 53, 51, 5, and 55. They influence many other factors without being influenced themselves. The Intermediate Factors (Levels 2 to 18) influence and are influenced by other factors, playing a central role in the system dynamics. The "Top Factors" (i.e., Level 1) are 7 and 10, primarily influenced by other factors without influencing others in turn.

5 Decision Support

There exist various decisions or decision-support steps that may be supported by the result of the ISM model, i.e., from analyzing the obtained Digraph, for example: *identifying leverage points; identifying existing feedback loops; determining priorities amongst leverage points; and the sequencing of actions on the leverage points*, [11], [13], [14].

Candidate leverage points are variables with the highest numbers of outgoing connections, thus the following variables: 1, 2, 3, 4, 5, 6, 8, 9, 49, 51, 53, 54, and 55. Those amongst the candidates with no incoming connections, among the candidates, are 5, 51, 53, 54, and 55, making them definitively leverage points. The remaining variables (1, 2, 3, 4, 6, 8, 9, 49) have non-zero incoming connections and are significantly influenced by at least one already identified leverage point. For this reason, they cannot be leverage points anymore.

A feedback loop for variable I exists if an indirect path starts and ends at variable I, [5]. This is detected when the diagonal of the final reachability matrix shows a 1*, indicating that i can reconnect to itself via an indirect path. In our case, loops appear only around variables 1, 2, and 3. Therefore, we have a total of feedback loops, as illustrated in Figure 13 (Appendix).

To determine priorities, we rank the leverage points based on one specific chosen METRIC: the number of outgoing elements from each leverage point, [14]. The leverage point with the highest value of this METRIC is given the highest priority. In case of a tie, the leverage point with fewer incoming connections is preferred, or a random choice is made if the incoming connections are also equal in number. The priority list obtained for our case here is shown in Figure 14 (Appendix).

Regarding cross-effects, variables (leverage points) that experience global cross-effects (Overall) do not exist because variables (leverage points) undergoing global cross-effects are those found in the intersection of the outgoing baskets of all variables (leverage points). In our system, this intersection is the empty set, [7], [10], [11], [13]. Variables (leverage points) experiencing pairwise cross-effects are identified from the intersection of their outgoing baskets. Then, we identify the variables (leverage points) in this intersection that are not found in the global intersection; these variables undergo the cross-effect of these two leverage points. For our issue, we take two examples to illustrate this pairwise cross-effect.
For levers 5 and 51, we have Figure 15 (Appendix)

There is no cross-effect between 5 and 51 because the intersection between 5 and 51 and the global intersection is an empty set.

For levers 53 and 55, we have Figure 16 (Appendix).

Factors 9 and 51 experience a cross-effect between 53 and 55 because the intersection between the intersection set of 9 and 51 and the global intersection is 9 and 51.

Finally, for “action sequencing,” the idea is to start actions with the leverage points that influence the largest number of variables to create a significant initial impact, [14]. If multiple leverage points exist, we start with those having the highest priority. The sequencing result is presented in Figure 17 (Appendix).

6 Comparison between CLD and ISM in Churn Management

This section aims to compare the effectiveness of CLD and ISM in churn management based on the analyses conducted in this work.

6.1 Discussion of general Strengths and Weaknesses of CLD according to the Literature

Causal Loop Diagrams (CLD) are practical for visualizing feedback in complex systems by illustrating causal relationships in a simple and accessible manner. They help identify potential leverage points by highlighting significant feedback loops, [15]. However, CLDs lack quantification of relationships between variables, complicating the precise prediction of outcomes. As the number of variables increases, CLDs can become difficult to interpret and do not prioritize interventions, which may limit their effectiveness in complex systems such as mobile telecommunications, [16]. The quality of CLDs also heavily depends on the expertise of the builders, which can affect the model’s accuracy.

6.2 Presentation of Findings based on CLD According to the reference sample Article

In [12], Causal Loop Diagrams (CLD) were used to model Churn in mobile telecommunications in Zambia, revealing several key points. CLDs illustrated interactions between service quality, competitor reactions, and retention initiatives. The study showed that improving customer service and reducing costs can decrease Churn, while delays in problem management increase churn rates. CLDs highlighted the importance of feedback loops and continuous monitoring for better resource management. However, while CLDs identify causal relationships, they do not prioritize interventions or precisely quantify impacts. The study, [12], shows that CLDs are valuable for understanding churn dynamics but often require complementary methods, such as ISM, to optimize strategic decision-making.

6.3 Identification of new Elements and Decisions Produced by the Detailed ISM, those reaching ISM, beyond CLD Capabilities

Interpretive Structural Modeling (ISM) offers notable advantages over Causal Loop Diagrams (CLD), particularly regarding variable prioritization and identifying strategic leverage points. Unlike CLDs, which display interactions without clear priorities, ISM focuses on the most impactful interventions and quantifies interactions between variables for a more precise understanding of their potential impact, [11]. In the context of Churn, ISM helps assess the effect of improvements on reducing Churn, thus facilitating more accurate investment planning. It also optimizes the sequencing of actions by identifying the order of necessary interventions to maximize their effectiveness, [17]. ISM reveals hidden relationships between variables, such as the indirect impact of brand perception, thereby providing a proactive and strategically aligned approach to customer attrition management, surpassing the capabilities of CLDs.

6.4 Comprehensive Comparison Synthesis of CLD and ISM Based on a Motivated List of Criteria

Table 2. compares CLD and ISM in managing complex systems, as the one considered in this study. ISM outperforms CLD in nearly all criteria.

Table 2: Synthesis of a Comprehensive Comparison of CLD and ISM Based on a Motivated List of Aspects.

Criterion	CLD	ISM
Feedback Visualization	Effectively represents feedback loops	Integrates feedback within a hierarchical structure
Simplicity and accessibility	Simple and easy to use	Slightly more complex to understand
Quantification of interactions	Does not quantify relationships	Allows for quantification and prioritization of interactions
Hierarchy of variables	No prioritization mechanism	hierarchy based on influence and dependence
Sequencing of actions	No clear sequencing of interventions	Allows for planning and sequencing of actions
Adaptability	Adaptable but becomes complex with many variables	Structured, well-suited for complex systems
Identification of leverage Points	Identifies levers but without prioritization	Identifies and prioritizes strategic levers
Ability to reveal hidden relationships	Limited to what is explicitly modeled	Reveals hidden and indirect relationships
Proactive churn management	Limited for proactive planning	Facilitates proactive management with strategic interventions

7 Conclusion

This research examines the conventional churn management approaches and their impacts and drawbacks in the context of customer loss minimization in the mobile telecommunications industry. Although useful for the first assessments, traditional approaches frequently need help ranking the measures to be instituted and evaluating the multidimensional relationships between various variables influencing Churn.

On the other hand, the ISM Application interprets the structure in quite a different way, and the changes from the top to the bottom significantly help to manage Churn by formulating strategies for it. ISM establishes clear attribution links and sensible relationships across identifiable factors, which enhances the overall understanding of the issues it seeks to address. Such a method helps identify critical leverage points, improving planning and decision-making.

So, the main advantage of ISM methodology is that it provides an ordered set of frameworks for evaluating the dynamics of Churn, thus facilitating the formation of the appropriate approaches to improve customer loyalty. This paper emphasizes the need to employ ISM modeling to overcome the challenges posed by the traditional approaches, thereby providing more meaningful and applicable aspects of churn management.

7.1 Summary of this Article's Contributions

This study emphasizes the challenges associated with traditional methods like Causal Loop Diagrams (CLD) and Relationship Diagrams (RD) tackling Churn in mobile telecommunications. These methodologies often need help prioritizing interventions and accurately quantifying the intricate interactions among various variables, thus limiting effective churn management strategies.

The ISM methodology provides a comprehensive framework through systematically organizing variables in a hierarchical structure. This framework enhances understanding of complex relationships and interactions, thereby providing deeper insights into the factors influencing Churn. Organizations can accurately identify critical leverage points by employing ISM, enabling focused interventions and informed strategic decision-making.

ISM outperforms traditional methods by delivering enhanced accuracy and actionable strategic recommendations. It promotes proactive churn management through comprehensive and systematic analyses of the factors leading to customer attrition. This improved clarity aids in formulating effective strategies and encourages informed decision-making to decrease Churn and enhance customer retention.

7.2 Observed Limitations of ISM

ISM (Interpretive Structural Modeling) assists in managing Churn despite its limitations. One of the main limitations of ISM is the number of resources and the time required for constructing a viable model.' This requires high-quality and detailed data information and system modeling skills, which are challenging for specific organizations.

Moreover, even though ISM explains systems structure and dynamics and their interrelationships quite well, there is a shift in the focus of the remaining analysis tools to more quantitative approaches. This limitation may require the application of other quantitative techniques in order to analyze the factors leading to churn comprehensively. Applying ISM and other quantitative methods, such as statistics, will likely lead to better insights into the Churn numerical aspect.

Also, the use of ISM may lead it to focus only on the details of the interrelations rather than the interrelations themselves, which have a more complex hierarchy. These interrelations can be articulated within a hierarchy that requires ISM to emphasize certain subtle and complex dynamics, so rather than enriching the understanding, it may limit it. To mitigate these limitations and improve the efficacy of churn management strategies, ISM is frequently most effective when employed alongside other analytical methodologies. Integrating ISM with quantitative methods and additional analytical tools can yield a more comprehensive understanding of churn dynamics, thus enhancing the overall strategy for managing customer attrition.

7.3 Brief Overview of Future Work

This study represents the first phase of our analysis, focusing on qualitative aspects. Future work could explore the integration of ISM with quantitative methods, such as simulation techniques (here, for example, the Stock-and-Flows diagrams of System Dynamics) or predictive models, to better quantify relationships between variables and provide a more comprehensive analysis of Churn. Applying ISM to other market segments or industries would also be interesting in assessing its flexibility. Finally, automating certain steps of ISM could make it more accessible while maintaining model accuracy. These future research directions aim to enhance the effectiveness and application of ISM in churn management.

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APPENDIX

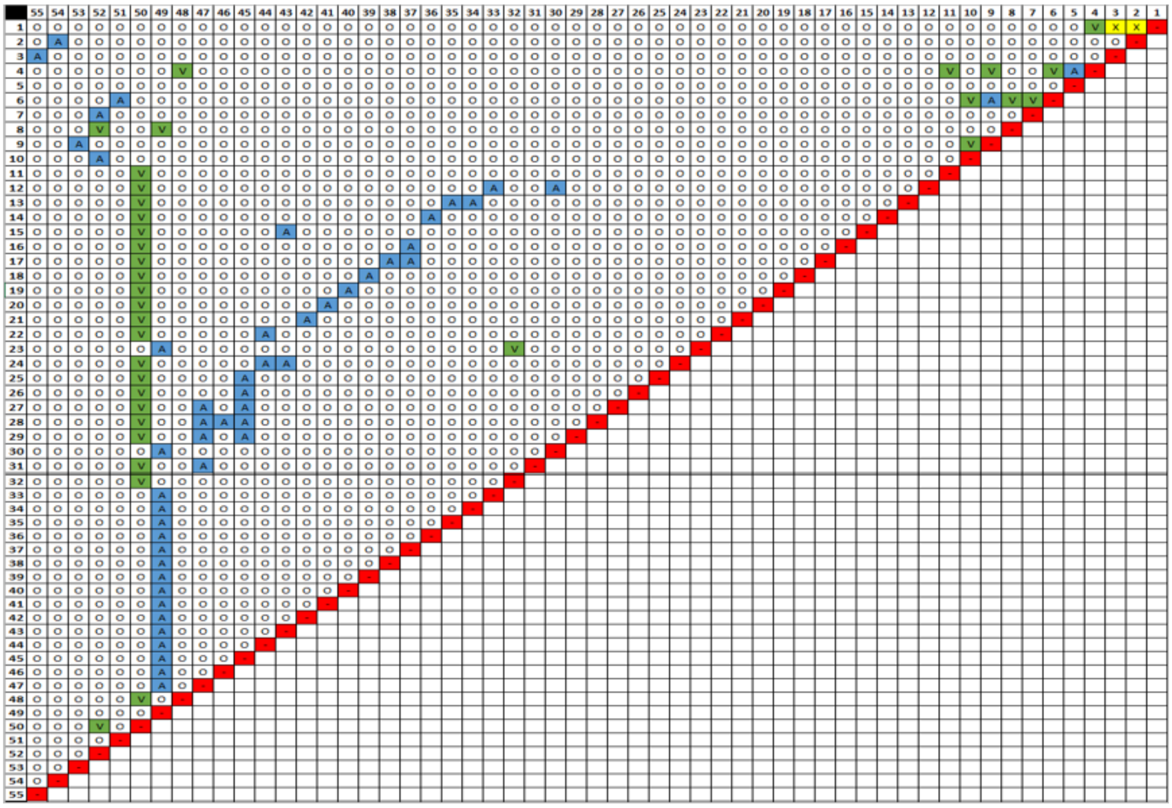

Figure 5: SSIM Matrix of the Churn Management System

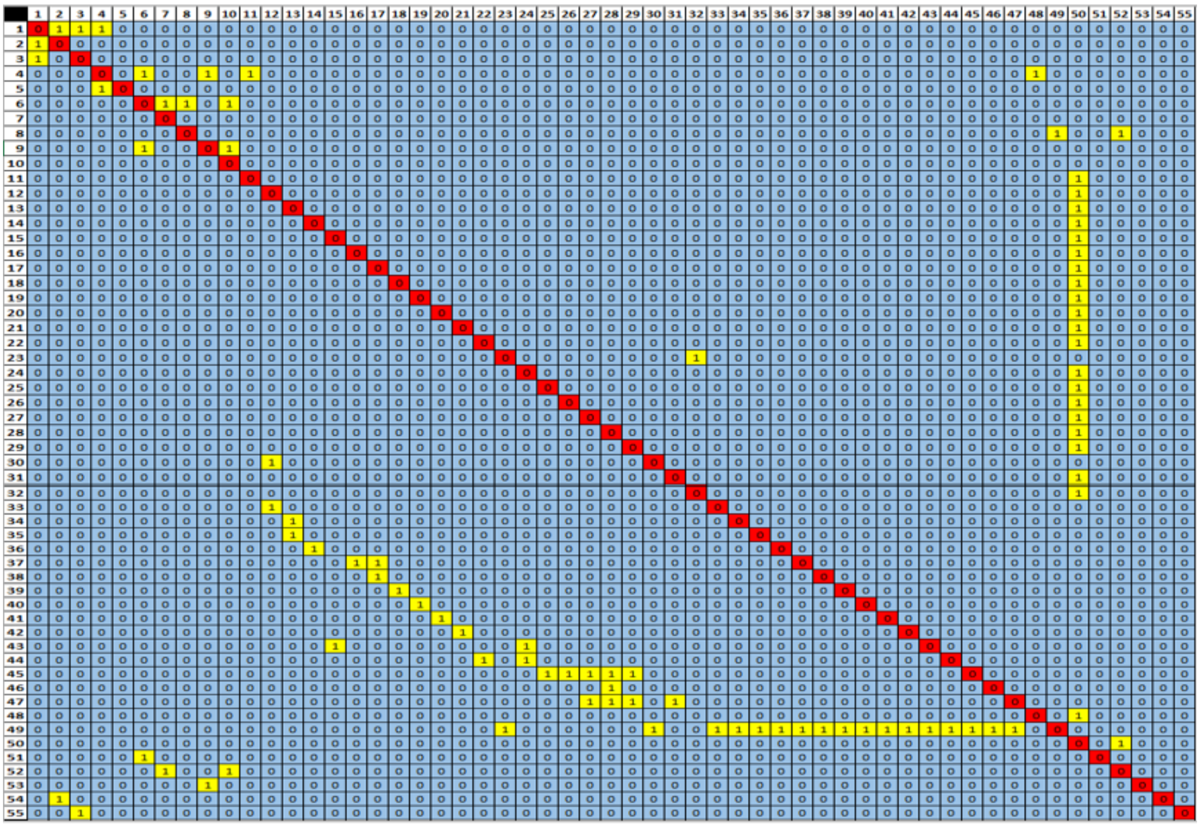

Figure 6: Initial RM Matrix of the Churn Management

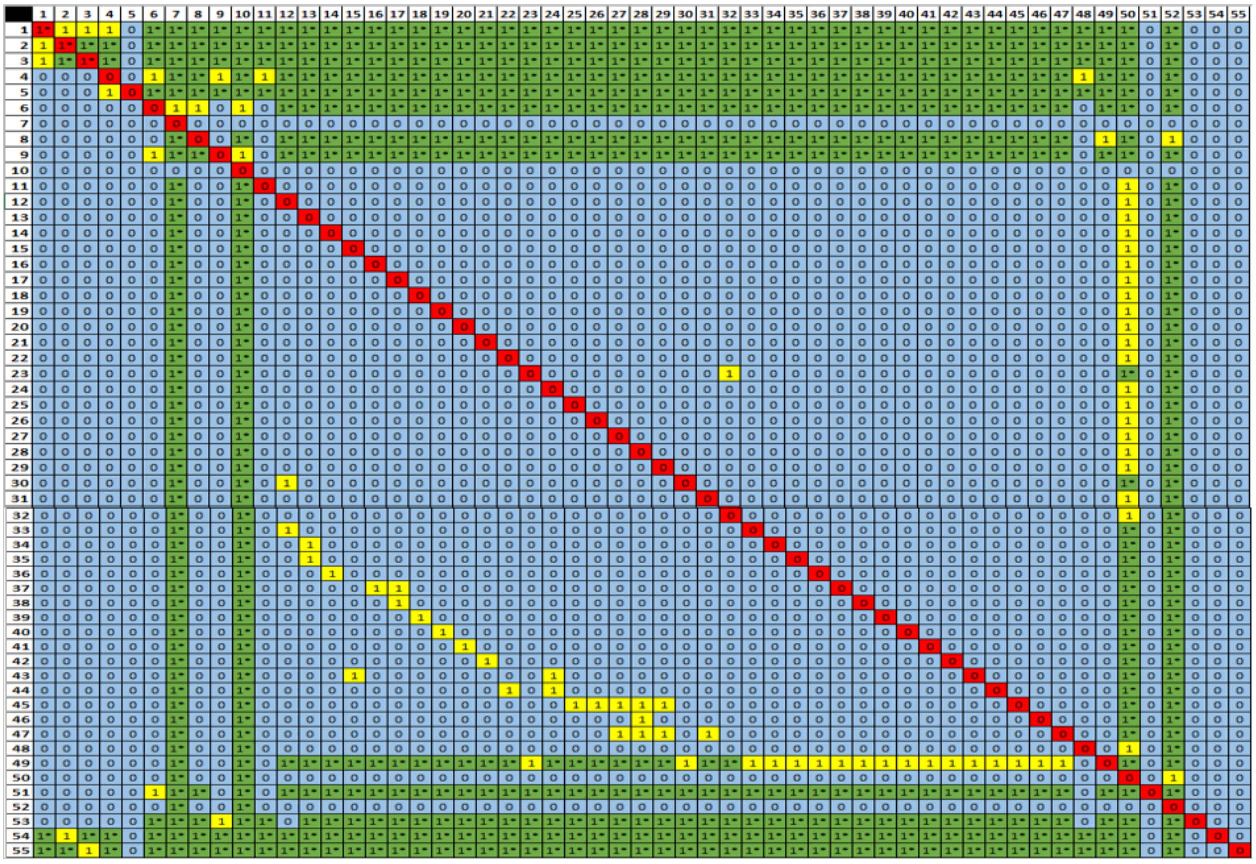

Figure 7: RM Matrix with transitivity in Churn Management

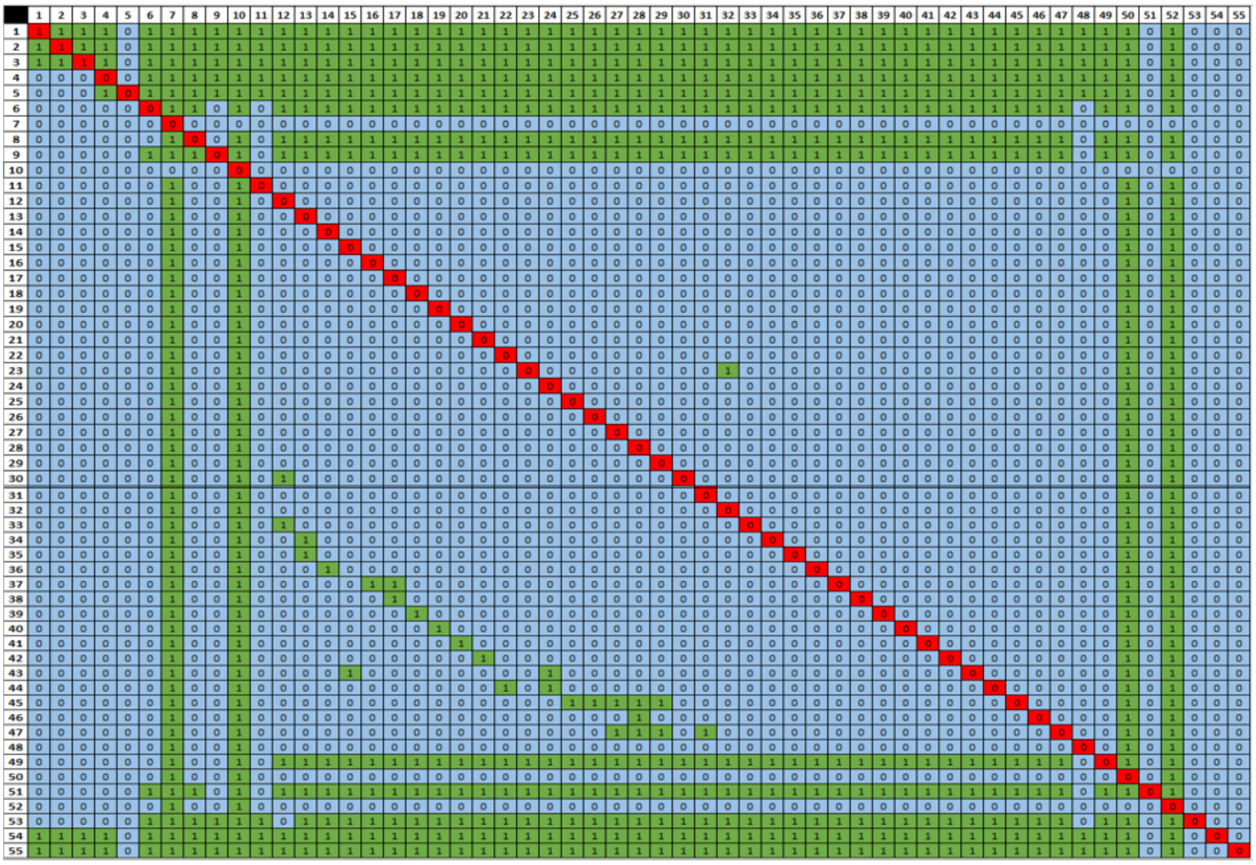

Figure 8: Final RM Matrix for Churn Management

Part 1

Variables	Dependency power	Driving power	Level
7	53	0	I
10	53	0	I
52	52	2	II
50	51	3	III
28	16	4	IV
13	15	4	V
17	15	4	V
24	15	4	V
27	15	4	V
29	15	4	V
12	14	4	VI
14	14	4	VI
15	14	4	VI
16	14	4	VI
18	14	4	VI
19	14	4	VI
20	14	4	VI
21	14	4	VI
22	14	4	VI
25	14	4	VI
26	14	4	VI
31	14	4	VI
32	14	4	VI
23	13	5	VII
30	13	5	VII
33	13	5	VII
34	13	5	VII
35	13	5	VII
36	13	5	VII

Part 2

38	13	5	VII
39	13	5	VII
40	13	5	VII
41	13	5	VII
42	13	5	VII
46	13	5	VII
37	13	6	VIII
43	13	6	VIII
44	13	6	VIII
47	13	8	IX
45	13	9	X
49	12	40	XI
8	11	41	XII
6	10	42	XIII
11	8	4	XIV
9	8	43	XV
48	7	4	XVI
4	6	46	XVII
1	5	50	XVIII
2	5	50	XVIII
3	5	50	XVIII
51	0	43	XIX
53	0	44	XX
5	0	47	XXI
54	0	50	XXII
55	0	50	XXII

Figure 9: Variables partitioning by level

Variables	7	10	52	50	28	13	17	24	27	29	12	14	15	16	18	19	20	21	22	25	26	31	32	23	30	33	34	35	36	38	39	40	41	42	46	37	43	44	47	45	49	8	6	11	9	48	4	1	2	3	51	53	5	54	55
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
52	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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21	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	1	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	1	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	1	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	1	1	1	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43	1	1	1	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44	1	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
47	1	1	1	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	1	1	1	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
11	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
48	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
51	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
53	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
54	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
55	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0

Figure 10: Cone Matrix obtained for Churn Management

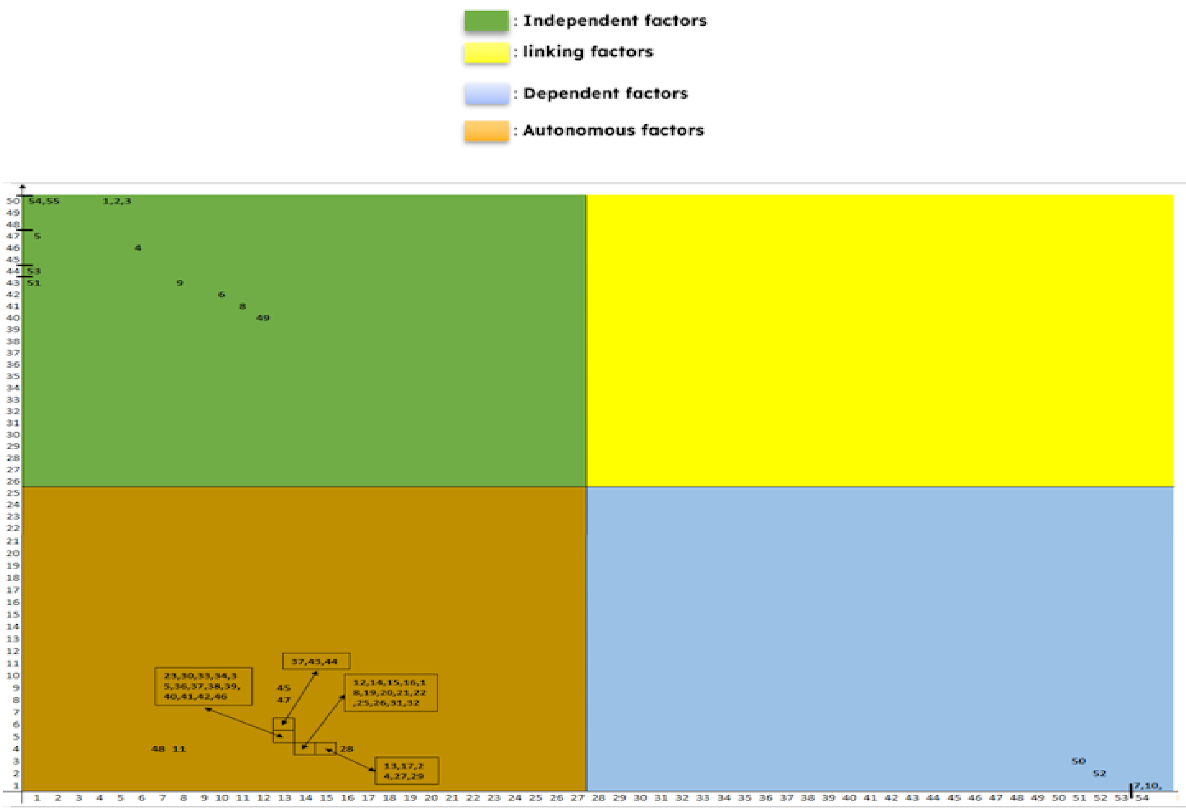

Figure 11: Factors Matrix

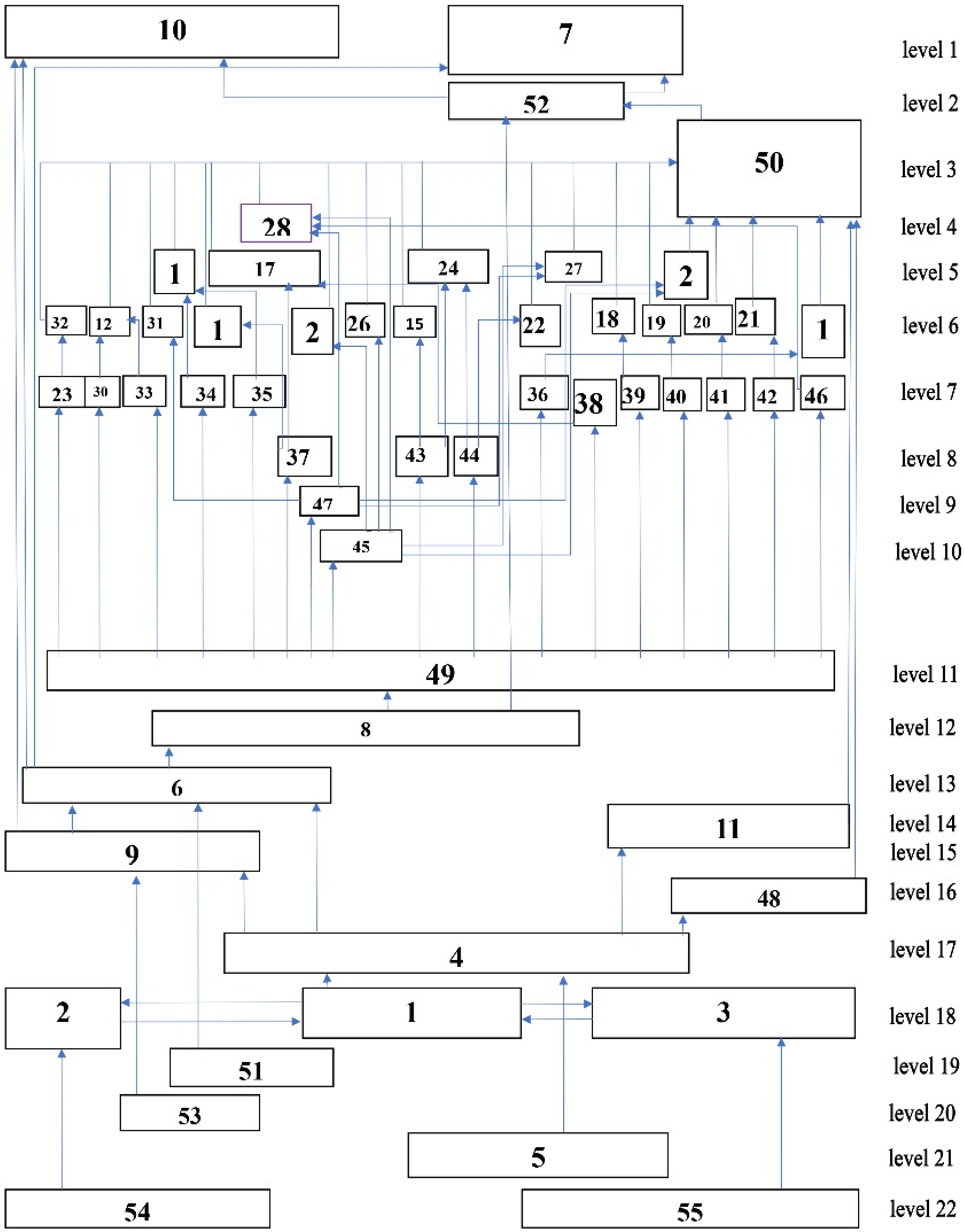

Figure 12: Final Digraph (having 22 levels) for Churn Management

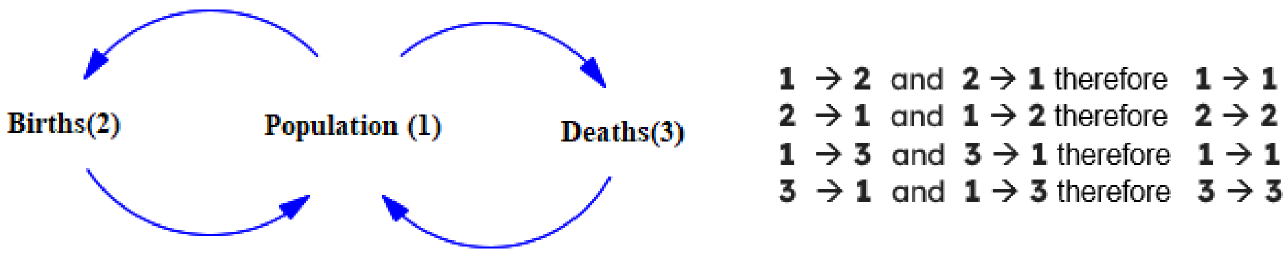

Figure 13: Non-exhaustive example of system loops identified in the Churn Management System

Leverage Points	Outbound Basket (Accessibility Set)
55	1,2,3,4,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,52
54	1,2,3,4,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,52
5	4,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,52
53	6,7,8,9,10,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,49,50,51,52
51	6,7,8,10,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,49,50,52

Figure 14: Prioritization of Leverage Points, the highest priority is listed first

Leverage Points	Outbound Basket (Accessibility Set)
5	4,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,52
51	6,7,8,10,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,49,50,52
Intersection between 5 and 51	6,7,8,9,10,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,49,50,51,52
Global Intersection	6,7,8,10,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,49,50,52
Variables affected by the cross-impact	-

Figure 15: Cross-effect between the leverage point variables 5 and 51

Variables	Outbound Basket (Accessibility Set)
53	6,7,8,9,10,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,49,50,51,52
55	1,2,3,4,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,52
Intersection between 53 and 55	6,7,8,9,10,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,49,50,51,52
Global Intersection	6,7,8,10,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,49,50,52
Variables affected by the cross-impact	9,51

Figure 16: Cross-effect between the leverage point variables 53 and 55

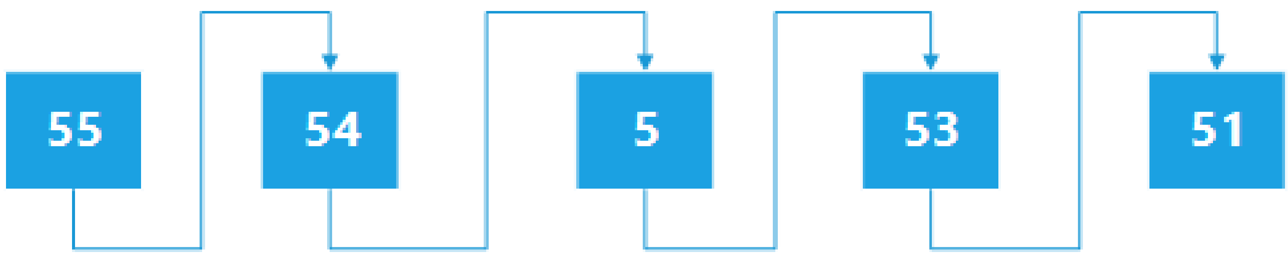

Figure 17: Sequencing of Actions which can be made for optimizing the Churn Management. Notice, however, that the optimization process (in the defined sequencing) itself can only be made in later phases where a quantitative model of the system (e.g., the stock and flows diagram of system dynamics) is available.