ANALYZING AND IMPROVING CHICKEN MEAT SUPPLY CHAIN USING BEER'S VSM, SCOR MODEL AND ACKOFF'S CIRCULAR ORGANIZATION

Kowsar Darivandi Shoushtari[1], Hossein Ghasemi[2], Mansooreh Zarezadeh[3]

1 Department of Industrial Engineering, University College Of Engineering, University Of Tehran, Tehran, Iran

2 Faculty of Management, University Of Tehran, Tehran, Iran

3 Faculty of Management and Economics, Tarbiat Modares Univrsity, Tehran, Iran

ABSTRACT

This paper deals with diagnosing broiler meat supply chain and designing a new metasystemic (in cybernetic terms) structure for it in Iran. The analysis has been informed by functionalist, interpretive and emancipatory paradigms. A combination of Beer's VSM and SCOR model are utilized for analyzing the situation. Resourced-based view is used in a complementary role for analyzing system2 requirements and strategic environmental relations. A new structure is proposed for the managerial body of the supply chain applying Ackoff's circular organization model which will relieve existing deficiencies.

Keywords: The Viable System Model, Broiler Meat Supply Chain, Resource-based View, Circular Organization

INTRODUCTION

Chicken meat is a high consumed agricultural product and the main source of protein in the world. Well-managed broiler supply chains can have a significant contribution to food security, occupation and GNP of nations. Production in the agricultural section confronts challenges in every country. High production cycle, high risk and market instability are some of the main challenges of agricultural production. Broiler industry confronts the mentioned difficulties, too. A chicken meat supply chain consists of a line farm, GP (Grand Parent) farm, parent farm (P), broiler farm, slaughterhouse and the distribution channel. Figure 1 shows a chicken meat supply chain.

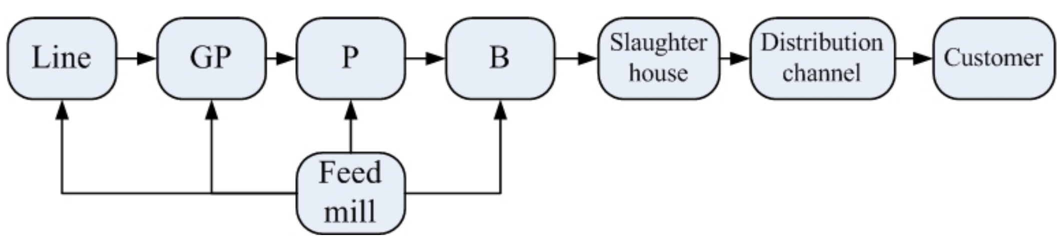

Figure 1: Chicken Meat Supply Chain

A whole broiler supply chain is a complex socioeconomic system which has different aspects. Managing a complex system is a complex task. The more aspects of a system included in a study, the more systemic it would be. Different paradigms can provide insight from variant worldviews. According to Jackson (2003) four sociological paradigms are prevalent in the today management world- functionalist, interpretive, emancipatory and postmodern. The problem being addressed in this article is studying and improving a chicken meat supply chain, taking advantage of systems methods. Models which are especially built for studying complex systems can help managers analyze and improve the situation. Stafford Beer's viable system model is a powerful model built for this purpose. In this article the model is used for analyzing a whole supply chain from the viewpoint of functionalism. Also ideas from interpretive and emancipatory paradigms are used in analyzing the situation. Then a new structure for managing the supply chain is proposed utilizing Ackoff's circular organization (or democratic hierarchy).

THEORIES

Functionalist, Interpretive and Emancipatory Sociological Paradigms

Paradigm refers to the worldview underlying the theories of a scientific discipline. As mentioned by Burrell and Morgan (1979) and Jackson (2003) there are four paradigms prevalent in social theory today- functionalist, interpretive, emancipatory and postmodern. The functionalist paradigm seeks to ensure well-functioning of the system by using scientific methods. The interpretive paradigm focuses on subjectivity and the meanings and purposes that people bring to their activities. It seeks to make a shared meaning among key stakeholders. The emancipatory paradigm seeks to emancipate oppressed individuals and groups in organizations and society. The postmodern paradigm opposes the rationality of the other mentioned paradigms. It encourages variety and diversity to raise conflicts and emphasizes having fun. Using a variety of paradigms will result in a more holistic view than using just one paradigm.

The paradigms underlie systems theories with a social concern (Jackson, 2003). Therefore using systems methodology lets using the paradigms in action.

Organizational Cybernetics

Organizational cybernetics is a functionalist systems approach the aim of which is maintaining system viability in a turbulent environment. The approach is based on cybernetic concepts – feedback, black box, variety engineering, etc. - and neurophysiology of human body. The viable system model (VSM) is in heart of organizational cybernetics and is the essence of all principles which the approach is based on. VSM shows essential characteristics which any system should feature if it is to be viable. Figure 2 shows the viable system model. VSM functions are described in the following.

System1 is implementation function of VSM and consists of operational elements which are directly engaged with creating value. System 1 elements are granted autonomy in their local environment. System 2 is called coordination and is the regulator of the system. As its name implies, system 2 coordinates the operational elements by using regulatory mechanisms such as rules, instructions, standards, protocols, schedules, etc.

System 3 is called operational control. It is responsible for internal stability. The main tasks of system 3 are managing service processes, resource bargaining (defining targets and boundaries of system 1 elements, devoting resources to them, defining their performance measures)**,** operational planning, performance control of operational elements and exerting authority when resolving internal conflicts demands it. System 3 never intervenes directly inside operational elements and views them as black boxes. System 3* provides direct access to operational elements for system 2, 3 on a sporadic basis. It checks if regulatory mechanisms passed by system 2 are obeyed and gathers data about actual performance of system 1 elements for system 3. System 4 is responsible for outside and future. It is called development and home to functions such as strategic planning, research and development, public relations, finance, etc. System 4 monitors the environment and detects environmental threats and opportunities. It builds a decision environment for system 5. Internal and external information come together to build such an environment. System 5 is called policy. It is the final authority of the system and defines system targets and structure. It also determines essential policies of the system. System 5 is responsible for balancing system 3 and system 4 demands; since system 3 emphasizes on stability and system 4 emphasizes on change. They may come into conflict sometimes.

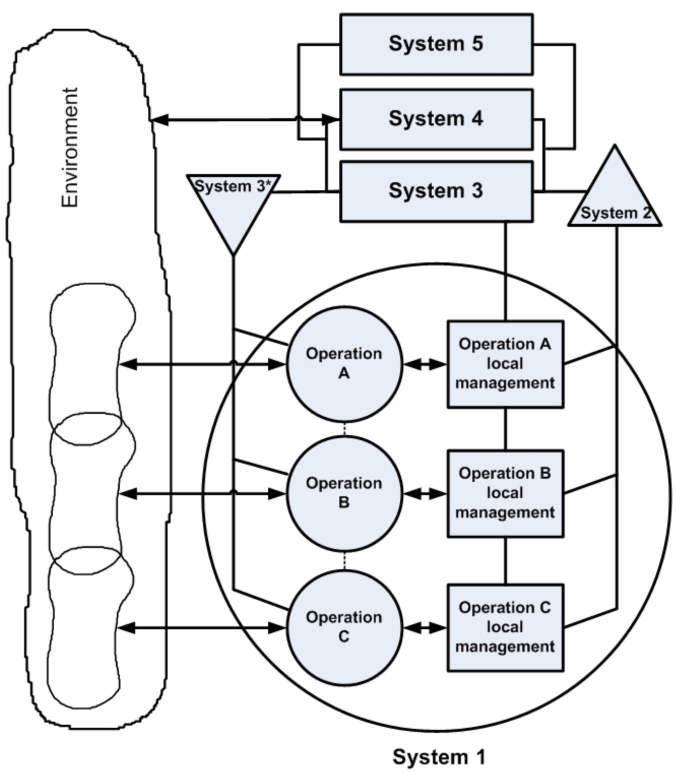

Figure 2: The Viable System Model

A system should perform the functions prescribed by VSM if it is to remain viable.

SCOR Model

Supply Chain Operations Reference-model (SCOR) is a process model and a diagnostic tool for supply chain management. The model spans from the supplier's supplier to the customer's customer and is based on 3 process levels. Level1 includes five managerial processes - Plan, Source, Make, Deliver, and Return. Each of level1 processes are the parent for level2 processes (configuration processes) and level3 processes are children of level2 processes. Level3 processes are business activities often derived from best practices. Table 1 shows process categories of SCOR model.

Table 1: SCOR Process Categories

<table>
<tr><td colspan="2"></td><td colspan="5">SCOR process</td></tr>
<tr><td colspan="2"></td><td>Plan</td><td>Source</td><td>Make</td><td>Deliver</td><td>Return</td></tr>
<tr><td rowspan="3">Process type</td><td>Planning</td><td>P1</td><td>P2</td><td>P3</td><td>P4</td><td>P5</td></tr>
<tr><td>Execution</td><td></td><td>S1-S3</td><td>M1-M3</td><td>D1-D4</td><td>S/DR1-S/DR3</td></tr>
<tr><td>Enable</td><td>EP</td><td>ES</td><td>EM</td><td>ED</td><td>ER</td></tr>
</table>

Circular Organization

Circular organization or democratic hierarchy is a method formulated by Ackoff to support democratic management. The method takes advantage of an interpretive basis. It is a combination of hierarchy and democracy. Figure 3 shows a circular organization.

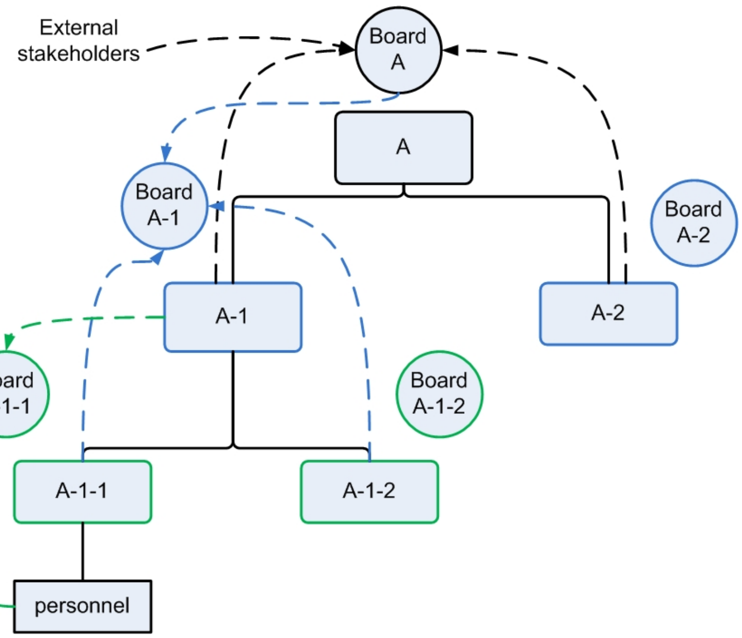

Figure 3: A Circular Organization

As displayed by the figure, in a circular organization a board is assigned to every manager. The boards consist of the corresponding manager, the immediate superior of this manager and the immediate subordinates of him. For the highest manager, external stakeholders are included in the board. The functions of the board are planning and policy for the unit whose board it is, coordinating subordinate units, integration the activities of the unit with two higher and lower level units, performance approval, appointment or dismissal of the head of unit.

LITERATURE REVIEW

Cybernetics has been used in variant fields. Fields of knowledge management and information systems (de Raadt, 1990; Gray, 2000; Kovacheva, 2006; Takahashi, 2006; Rios, 2006; Qiu-yan & Xiao-na, 2007; Rozenkranz & Holten, 2010), social, behavioral and organizational studies (Schwaninger & Koerner, 2004; Schwaninger, 2003; Schwaninger, 2004; Fransoo & Wiers, 2005; Jones, 2007), business process management (Vidgen, 1998; Di Mascio, 2002; Snowdon, 2007, Azadeh& Darivandi, 2010), environmental management (Lewis, 1997; Lewis & stewart, 2003) risk analysis (Foster, 1997), distribution and market studies (Benton & Kijima, 1998), financial (Morlidge, 2009) and production management systems (Padilla, 2009) has taken advantage of the approach. Jackson (2003) emphasized using systems methodology in combination. Schwaninger (2005) and Rios (2006) used organizational cybernetics with system dynamics and team syntegrity. Kinloch (2009) used organizational cybernetics with soft systems methodology. Donaires (2010) used organizational cybernetics with critical systems heuristics. This study is using organizational cybernetics with one of the methods employed by interactive planning.

Table 2 shows the status of the paper in literature.

Table 2: Literature Review Outline

application scale / application field	organization	supply chain	city, society or country	world wide
knowledge management and information systems	✓			✓
social, behavioral and organizational studies	✓		✓	
business process management	✓			
environmental management	✓		✓	
risk analysis	✓			
distribution and market studies	✓		✓	
financial	✓			
production management systems	✓	✓		
Agriculture (poultry)		contribution of this paper		

IDENTIFYING CURRENT SITUATION

Chicken Meat Supply Chain as a System

It is possible to conceive a chicken meat supply chain as a system which contains subsystems. Some of the subsystems are operational. They do the activities directly associated with the system objectives and are directly involved in creating value. Some are regulatory subsystems, the aim of which is coordination and directing the collective action of operational subsystems. The supply chain is also an operational element of a larger system. Figure 4 shows the supply chain as a system containing subsystems and also a subsystem of a larger system. The identity of operational and regulatory elements will be identified by exploring the structures and processes of the existing situation.

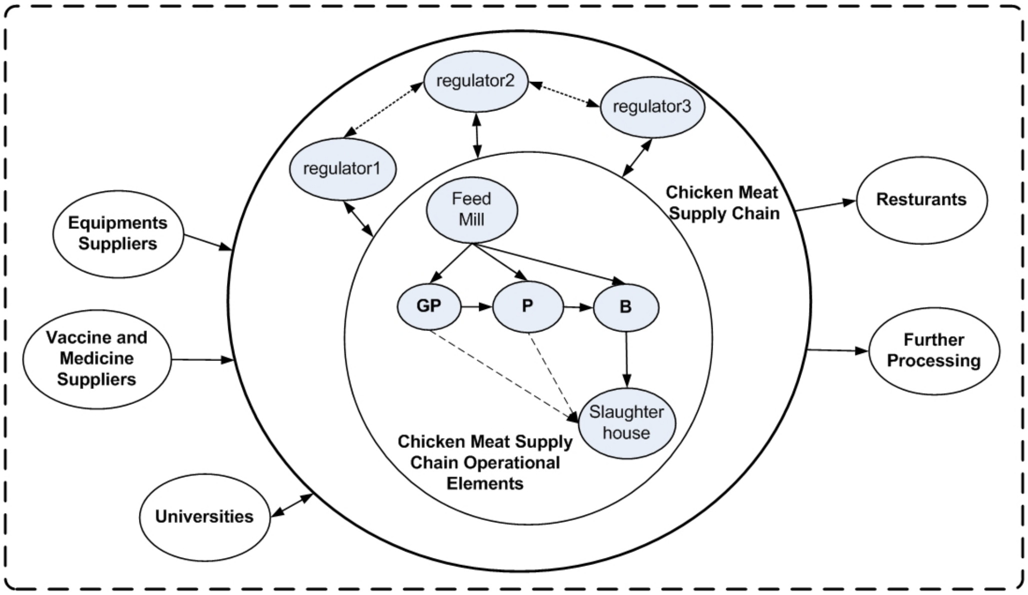

Figure 4: Chicken Meat Supply Chain as a System and a Subsystem

Chicken Meat Supply Chain Elements and Processes

SCOR is a process model and can be utilized as an aiding framework for process identification. However VSM is more general. It is not restricted to structures or processes and includes all functional aspects of the system. A combination of VSM and SCOR provides a rich framework for identifying the situation.

SCOR classifies supply chain management processes in 5 categories- plan, source, make, deliver and return each of them has planning, executive and enabler sub processes. Supply chain nodes which were introduced in previous sections, perform executive processes of the supply chain, from source to deliver. It is noteworthy that there is no return process in chicken meat supply chain because of the nature of the product. Operational elements of supply chain which perform executive processes are equivalent to VSM system 1 elements. Figure 5 shows the combination of SCOR and VSM. The executive processes are as follows:

- **Source**
    - Producing poultry feed;
    - Producing day-old-chicken
        - Rearing line poultries and producing GGP chickens;
        - Rearing GP poultries and producing parents chickens;
        - Rearing parent poultries and producing day old chickens;
- **Make**
    - Rearing day old chickens and producing grown broilers;

   - Slaughtering broilers and primary processing (segmentation);
- **Deliver**
   - Distribution and sales.

The planning and enabler processes are identified by analysis of supply chain as a viable system.

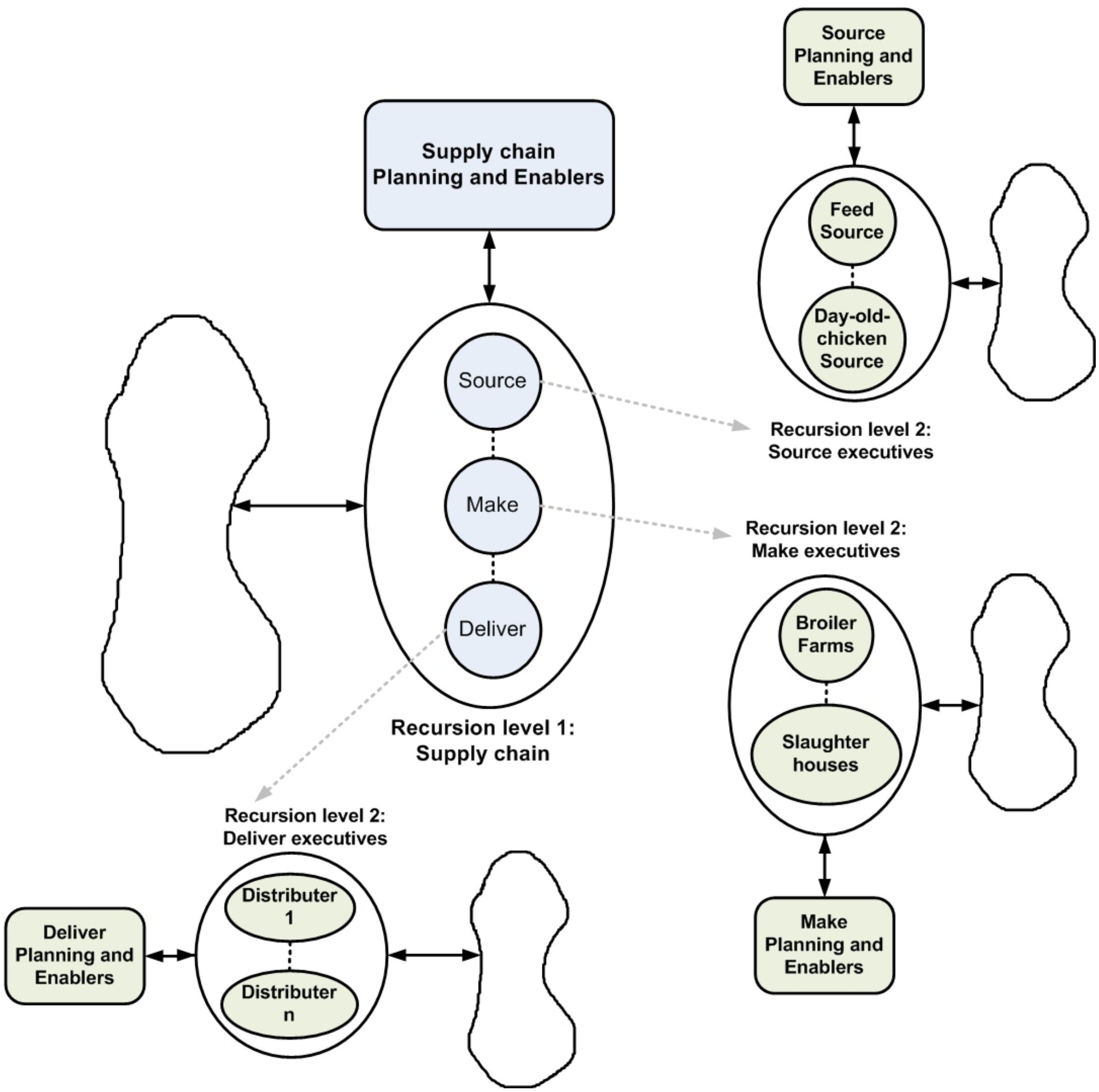

Figure 5: Combination of SCOR and VSM- Recursion Level 1 and 2

It is possible to unfold the supply chain in lower levels, too. The recursion of "source" may be unfolded in line, GP and P farms. They stand in recursion level 3. Individual farms stand in recursion level 4.

A system is not defined just by the identity of its subsystems but also with the kind of interactions among them. Different relations among supply chain nodes will result in different features for the supply chain. If a common owner owns all companies of a supply chain, then it is called a vertical integration. Vertical integration is the most integrated structure of a supply chain. A vertical integration is selected for further studies. Figure 6 shows the organizational structure of the company.

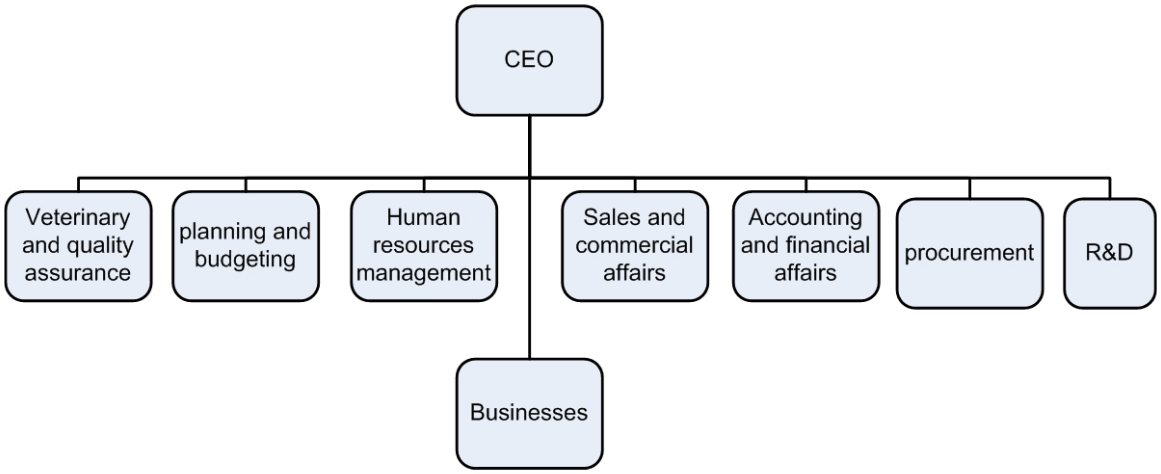

Figure 6: The Organizational Structure of the Concerned Integrated Company

The businesses include 3 feed mills, 1 GP farm, 4 parent farms, 90 broiler farms (contract farmers), 5 slaughter houses and distributers. The businesses are geographically distributed. The farms are located in the north of Iran while slaughterhouses and distributors are mostly near to the big markets such as Tehran. The company has contracts with distributers such as chain stores, wholesalers, restaurants, further processing firms, etc for product distribution. It owns some wholesalers as well.

ANALYZING THE SITUATION

Functionalist Analysis

For analysing the functional aspect of the situation, VSM functions requirements are compared with current situation with the focus on the level of supply chain. Resource-based view is utilized as a complementary approach for identifying VSM functions requirements. Warren (2008) categorized resources into tangible and intangible resources and introduced a checklist for tangible resources as follows:

- Customers (market)
- Products;
- Production variety;
- Staff;
- Cash.

Distinguishable resources of supply chain nodes are identified as Table 4 shows.

Table 4: Chicken Meat Supply Chain Nodes Resources

Resource / Node	Production capacity	Products and services variety
Feed Mill	Production capacity available maize, soybean and other raw materials	variety in feed appropriate for different ages of poultries (starter, grower, finisher); kind of feed
GP	Farming capacity; available inputs (chicken, feed, vaccine and medicine); equipments; Fuel (energy carriers).	-
P	Farming capacity; available inputs (chicken, feed, vaccine and medicine); equipments; Fuel (energy carriers).	-
B	Farming capacity; available inputs (chicken, feed, vaccine and medicine); equipments; Fuel (energy carriers).	-
Slaughter house	Production capacity.	whole chicken or parts / warm or frozen meat
distributor	transportation, storage and maintenance capacity	-

In addition to tangible resources, there are intangible resources such as data, information, knowledge, safety (like biosecurity) and reputation. In the following the current situation is analysed.

System 1 analysis

The defined organizational chart implies the company VSM such as Figure 7. There is the risk of disobeying the law of requisite variety because the tasks of lower levels of recursion are done concentrated in level 1. It seems that a managerial layer as recursion level 2 metasystem in Figure 5 has been missed. Long period of planning and budgeting process, inexistence of level 1 elements performance assessment process, great variety confronting "veterinary" and "production planning and control" units are evidences of variety imbalances. The cases are illustrated in the following.

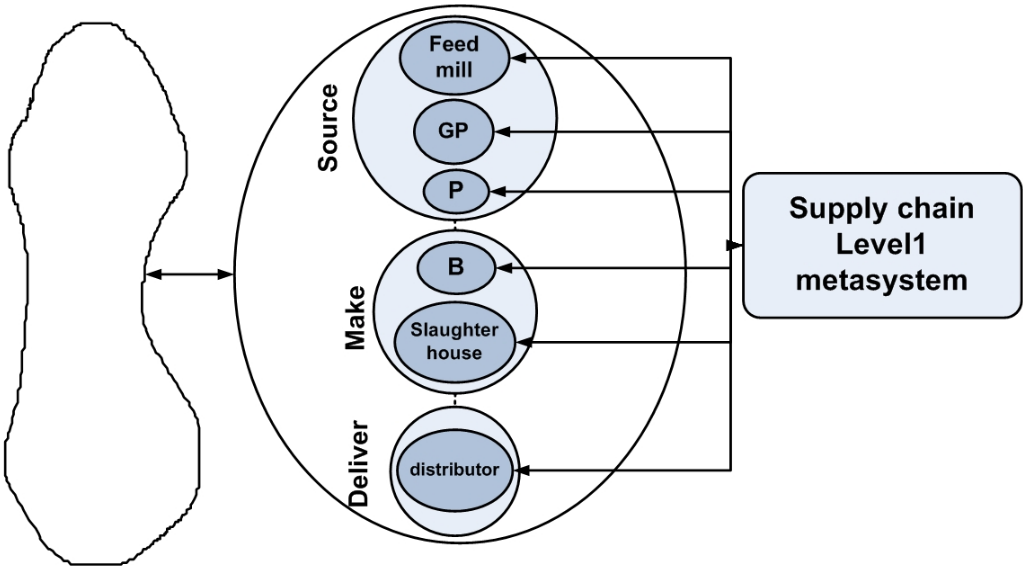

Figure 7: Current VSM of the Concerned Supply Chain

System 2 analysis

It is possible to consider 2 kinds of coordination requirements- task-based and issue-based. In order to analyze system 2, task-based coordination requirements are derived using resource-based view. Resources drive performance (Warren, 2008). Therefore it is possible to derive dependencies of businesses performance to each other by the resource-based approach. For instance dependencies between parent and broiler farms are identified in

Table 5. Dependencies between other nodes, such as broiler farm and slaughterhouse; feed mill and farms are identified similarly.

Table 5: Dependencies between Parent and Broiler Farms

B \ P	Farming capacity	Feed	P chicken	vaccine and medicine	fuel	Product variety	human resources	cash	market	information
Farming capacity									×	
Feed										
B chicken	×	×	×							
vaccine and medicine										
fuel										
Product variety						×				
human resources										
cash								×		
market										
information										×

The table can be described as follows. Farming capacity of P farms affects the quantity of available broiler day-old-chickens for B farms. The quality of P farms feed affects the quality of B chickens. Price of P farms feed and P chickens affect the price of B chickens. Quality of P chickens which are parents of B chickens affects the quality of B chickens. Broiler farming capacity determines the market for P farms....
Recognizing supply chain nodes dependencies, it would be possible to identify coordination requirements and considering proper mechanisms in response. In the concerned situation, following coordination requirements were recognized:

- Coordinating the quantity of nodes passed products- if one node is to deliver the expected quality, previous nodes should deliver qualified products to it and successor nodes should have sufficient capacity to absorb the outputs.
- Coordinating the quality of nodes passed products- if one node is to deliver the planned quantity, previous nodes should deliver adequate products to it. Passing unqualified products to subsequent nodes should be prevented.
- Coordinating nodes production schedules- if one node is to deliver the products as planned, previous nodes should deliver products on-time to it and the successor nodes should be ready to absorb the outputs.

Comparing coordination requirements and existing coordination mechanisms shows an imbalance between the supply chain production and the distribution channels capacity. Another problem with system2 was that there were no units responsible for organizing and coordinating standards and regulatory rules.

System 3 analysis

The main tasks of system 3 are:

- Operational planning;
- Resource bargaining (including defining system 1 elements borders, resources assignment and defining performance measures);
- Monitoring system 1 performance and feeding it back by intervening in operational elements inputs;
- Managing service processes;
- Resolving internal conflicts when an authority is needed.

A system 3 diagnosis reveals the following cases:

- Insufficient involvement of operational elements in planning and resource bargaining. No defined mechanism is in place for ensuring system1 participation in planning process. This is more focused in interpretive analysis;
- Variety imbalances for some service processes which appear as unsatisfactory service quality and process long duration. Lower level managers exert their natural autonomy in cases in need of professional expertise or quick action in spite of formal procedures;
- Lack of coordination among staff units in resource assignment and performance control of system1 elements. Table 7 shows how the authority of resources is distributed among staff units.

Table 7: Distribution of Resources Authority among Staff Units

Resource	authorized unit
feed ingredients (specifically maize and soybean)	planning and budgeting / procurement
farming capacity	planning and budgeting
vaccine and medicine	veterinary
equipments	procurement
fuel and energy	procurement
human resources	human resources management
cash	accounting and financial affairs
market	sales and commercial affairs

System 3 analysis*

System 3* provides a direct access to operational elements on a sporadic basis. It should check if regulatory rules defined by system 2 are obeyed and gathers data about system 1 elements performance. The required processes are defined but the difficulty with system 3* is the great variety it faces with. Especially inspecting and auditing broiler farms and distributors has become a dilemma for the units which deal with auditing task due to the high number and geographical distribution of them. Veterinary, sales and planning and budgrting are system 3* related units.

System 4 analysis

System 4 deals with outside and future. Analysis of the environment is the companion of system 4 analysis. As described by Hoverstadt (2008), in organic viewpoint an open system has some strategic relations with its environment, like an organism which is in relation with its environment such as absorbing oxygen, food, etc. The most important environmental relations are seeking resources such as raw materials and market from environment. In the following the most strategic relations of chicken meat supply chain with the environment are identified on a resource-based basis. Table 8 shows strategic relations and related environmental elements.

Table 8: Supply Chain Strategic Environmental Relations and Elements

Relation	Related environmental element	Related resource
Feed procurement	Feed market and suppliers	maize and soybean
GP chicken procurement	GP chicken market and suppliers	GP chicken
Vaccine and medicine procurement	vaccine and medicine market and suppliers	vaccine and medicine
Human resources recruitment	universities/ labor market	human resources
Cash provision and funding	Banks and financial institutes/ capital market	Cash
Marketing	chicken meat customers/ competitors	Market
Technology and equipments procurement	Equipments market and suppliers	Equipments
Natural resources provision	natural resources	water
Fuel and energy provision	Fuel and energy suppliers	Fuel and energy
Knowledge acquisition	universities/ educational institutions/ scientific societies/ conferences/ scientific publications/ experienced personnel	knowledge
data gathering	internet/ related organizations/ news agencies/ informal social networks in the industry	data
ecosystem interactions	ecosystem	biosecurity

The mentioned elements in the above table are in need of monitoring. Comparing the strategic relations which are in need of monitoring with the ongoing processes, the following shortcomings were recognizes in the situation:

- There is no process dealing with maize and soybean market anticipation while the oscillations of the market have been disturbing the production process continuously;
- There are no structured relations with universities for finding competent human resources, for transferring generated knowledge and for using research capability of them;
- The knowledge of company experts is not acquired, distributed and managed;
- Finance has not been done satisfactorily;
- R&D researches are restricted to animal affairs and don't cover business issues.

System 5 analysis

A system 5 analysis reveals an important shortcoming- weak coordination among metasystemic units. Metasystemic units are not well-coordinated and coherent. As discussed in previous sections the processes of resource bargaining and control are imbalanced and the metasystem lacks rich and on-time information flows. Negotiations confront difficulties because of divisional viewpoint of the units.

Interpretive and Emancipatory Analysis

The emancipatory paradigm tries to make possible for all stakeholders to express their views and opinions. The interpretive paradigm aims at making an efficient debate among different worldviews and reaching a shared vision among them. In the current situation there is no participation between stakeholders for making decisions, plans, etc. No formal mechanism is in place to ensure stakeholders participation.

PROPOSED METASYSTEM

A metasystem should be designed in a way that would resolve current issues. Inspired by Ackoff's circular organization a new metasystem is designed as described below.
Based on the combination of SCOR model and VSM, a local management is recognized for source, make and deliver sections of the supply chain and a board is established corresponding to each management body. The management bodies with the corresponding boards form the section metasystem. Figure 8 shows the proposed metasystemic network for managing the supply chain. The network may extend to lower levels of recursion if the law of requisite variety demands it. Every management body performs planning and enabler processes for the corresponding section of supply chain according to VSM metasystemic functions. Tasks of management bodies and the boards are shown in

Table 9. The combination of the boards is as follows:

- Source board: source manager, managers of the feed mills, GP and P farms, CEO
- Make board: make manager, managers of the B farms, slaughter houses, CEO.
- Deliver board: deliver manager, managers of distributer bodies, CEO.
- Supply chain board: CEO, Source manager, make manager, deliver manager and shareholders.

Source, make and deliver head managers can employ a managerial structure meeting their needs. Tasks of management bodies and boards are defined according to VSM functions, SCOR and what Ackoff defined as the boards duties.

Table 9 shows planning and enabler processes assigned to the metasystemic network.

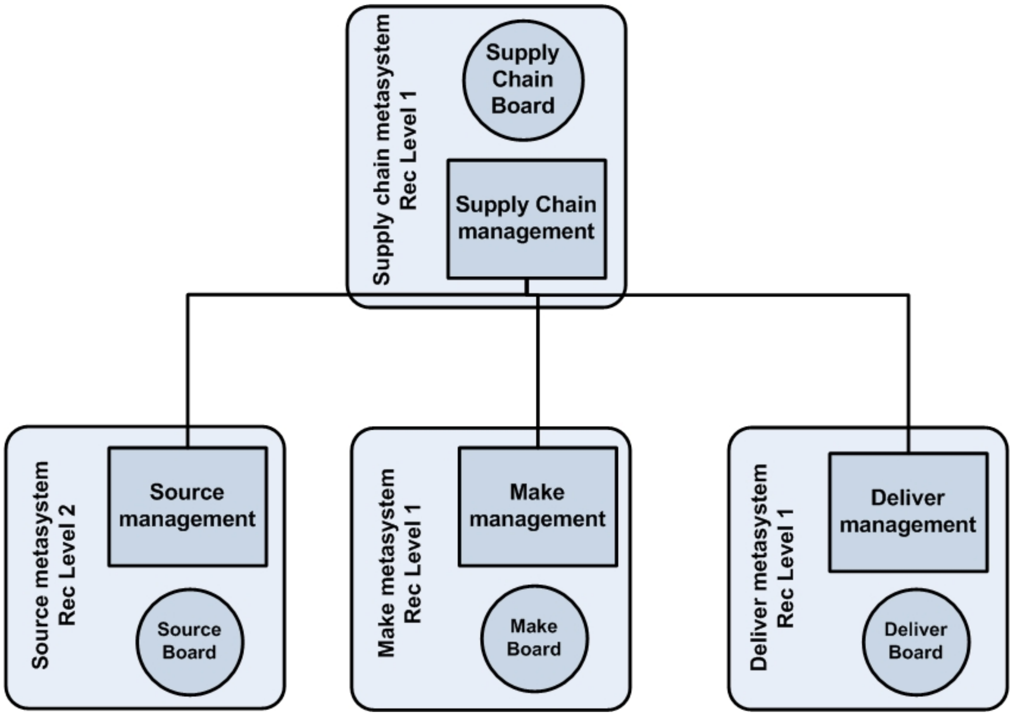

Figure 8: Proposed Metasystemic Network for Managing the Supply Chain

Table 9: Tasks of Management Bodies and Boards

	Task		corresponding VSM function	corresponding SCOR process category
Management bodies tasks	codifying regulatory rules and standards		system 2	Enabler
	Resource assignment to subordinate units		system 3	Enabler
	performance assessment and control of subordinate units		system 3	Enabler
	Managing service processes		system 3	Enabler
	Resolving internal conflicts among subordinate units		system 3	Enabler
	Monitoring strategic environmental relations and communicating important environmental elements	maize and soybean market and suppliers	system 4	Enabler
		GP chicken market and suppliers		
		vaccine and medicine market and suppliers		
		universities		
		capital market		
		chicken meat demand		
		competitors		
		Equipments market and suppliers		
		Fuel and energy supply		
		educational institutions and scientific societies		
		conferences		
		internet		
		news agencies		
		biosecurity and disease status in the environment		
	knowledge management (knowledge acquisition from experienced expertise)		system 4	Enabler
	designing corresponding section structure		system 5	Planning
	designing structure of managerial body of corresponding section		system 5	Planning
Boards tasks	Planning for corresponding section		system 3	Planning
	strategic planning for corresponding section		system 4	Planning
	Coordinating subordinate units (including production scheduling)		System 2	Enabler
	Integrating activities of the section with higher and lower level sections		System 5, system 3	Enabler
	Policy making for the corresponding section		system 5	Enabler
	Appointment, dismissal and performance assessment of the corresponding management body head		system 5	Enabler

The advantages of the proposed structure are as follows:

- Distributing metasystemic processes in the supply chain recursion levels and ease the difficulties of variety imbalances;
- Formal definition of processes which were performed in an unstructured way (like codifying and distributing rules and standards, monitoring important environmental elements, etc.).
- Coherence of metasystemic activities because of the defined boards;
- Democracy; providing the opportunity for stakeholders to express their viewpoints.

Figure 10 shows proposed versus current structure from Ashby's law viewpoint. As shown in the figure, the produced variety by the supply chain is absorbed by recursion level2 metasystems.

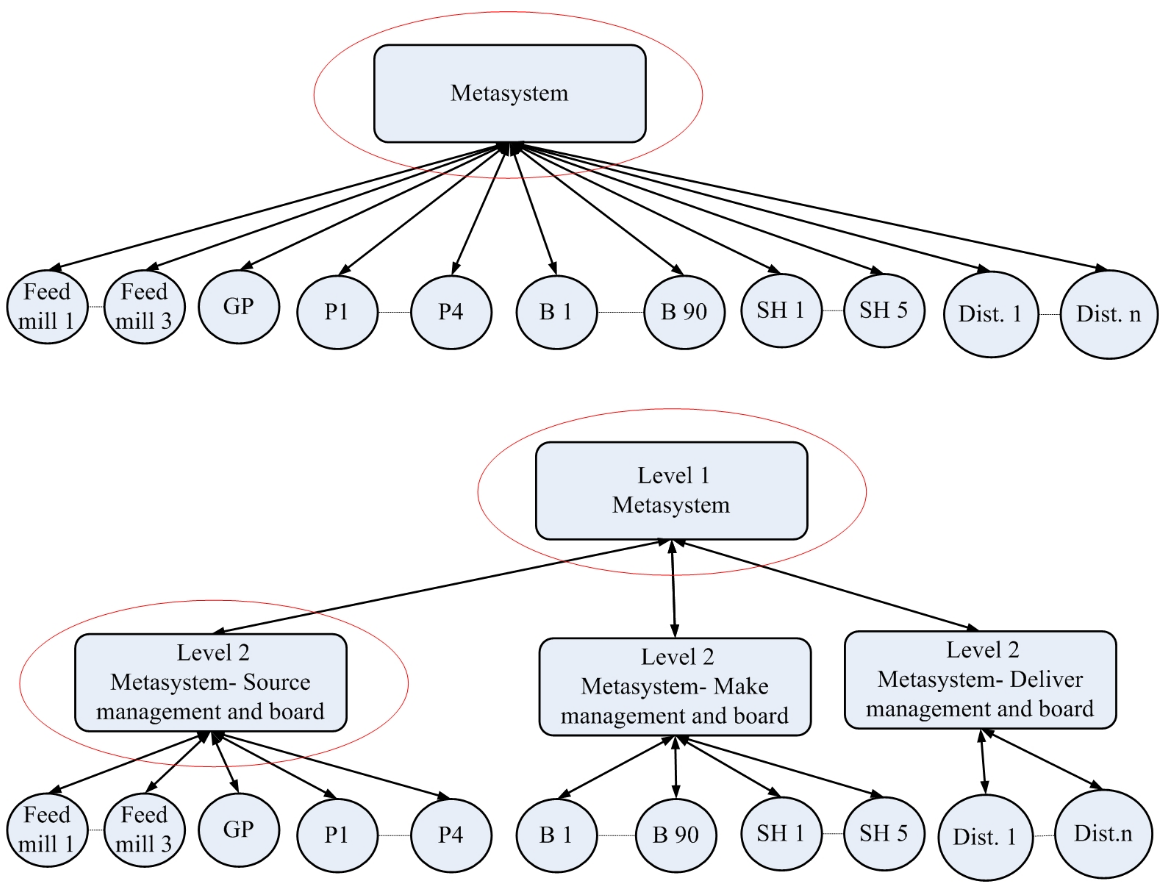

Figure 10: Produced Variety Would Be Absorbed By Level2 Metasystems

CONCLUSION

The paper basis is twofold. First it illustrates utilizing functionalist insightful methods in a complementary role alongside the viable system model. SCOR model and resource-based approach are used in this regard. Second the paper illustrates combining a functionalist and an interpretive method together which results in a rich organizational structure. A vertical integrated chicken meat supply chain is considered as case study. The proposed structure relieves existing shortcomings and provides a coherent metasystemic structure. The embedded boards ensure a good coordination and information flow among metasystemic elements as well as enabling stakeholders to express their ideas and exert their right to select and run their own future. The role of metasystem for an organization is equivalent to the brain for an organism. The more connected and coherent more resemblance to brain. Analysing an agricultural supply chain using organizational cybernetics and using circular organization in service of VSM are notable features of the article.

REFERENCES

Ackoff, R. L. (1981). *creating the corporate future.* John Wiley and sons.

Ashby, W. R. (1957). *An introduction to cybernetics.* London: Chapman & Hall.

Azadeh, A., & Darivandi, K. (2010). Diagnosing and improving business process using cybernetic laws and the viable system model. *first National Conference of Business Process Management.* Tehran.

Beer, S. (1972). *Brain of the firm.*

Beer, S. (1979). *The heart of enterprise.* Chishester: John wiley and sons.

Benton, C., & Kijima, K. (1998). Variety engineering in the Changing Competitive Environment of Japanese Retail Distribution. *Systems Research and Behavioral Science , 15* (1), 3-14.

Checkland, p., & Scholes, J. (1990). *Soft systems methodology in action.* John Wiley & sons.

de Raadt, J. D. (1990). Information transmission in viable systems. *Journal of the American Society for Information Science , 41* (2), 111-120.

Di Mascio, R. (2002). Service process control: conceptualizing a service as a feedback control system. *Journal of Process Control , 12* (2), 221-232.

Donaires, O. S., Pinheiro, M. G., Cezarino, L. O., Ostanel, L. H., & Martinelli, D. P. Systemic Model for Diagnosis of the Micro, Small and Medium Enterprises from Two Cities from the Countryside of the State of São Paulo in Brazil. *Systemic Practice and Action Research , 23* (3), 221-236.

Foster, K. J. (1997). cybernetic Risk Analysis. *Risk Analysis , 17* (2), 215-225.

Fransoo, J. C., & Wiers, V. C. (2005). Action variety of planners: Cognitive load and requisite variety. *Journal of Operations Management , 24* (6), 813-821.

Gray, P. H. (2000). The effects of knowledge management systems on emergent teams: towards a research model. *The Journal of Strategic Information Systems , 9* (2-3), 175-191.

Hoebeke, L. (2006). Identity: The paradoxical nature of organizational closure. *Kybernetes , 35* (1/2), 65-75.

Hoverstadt, P. (2008). *The fractal organization: creating sustainable organizations with the viable system model.* John Wiley & sons.

Jackson, M. C. (2003). *Systems thinking: creative holism for managers.* John Wiley and sons.

Jones, S. J., Rodriguez-Diaz, A., Hall, L., Castanon-Puga, M., Flores-Gutierrez, D. L., & Gaxiola-Pacheco, C. (2007). A cybernetic approach to multi-agent system simulation in Tijuana-San Diego using the viable system model. *IEEE International Conference on Systems, Man and Cybeernetics*, (pp. 1648-1652). Montreal.

Kinloch, P., Francis, H., Francis, M., & Taylor, M. (2009). Supporting crime detection and operational planning with soft systems methodology and viable system model. *Systems Research and Behavioral Science , 26* (1), 3-14.

Kovacheva, T. (2006). Viable model of the enterprise- a cybernetic approach for implementing the information technologies in management. *International Journal "Information Theories & Applications" , 13* (4), 337-340.

Lewis, G. J. (1997). A cybernetic view of environmental management: The implications for business organizations. *Business Strategy and the Environment , 6* (5), 264-275.

Lewis, G., & stewart, N. (2003). The Measurement of Environmental Performance: An Application of Ashby's Law. *Systems Research and Behavioral Science , 20* (1), 31-52.

Leonard. A. (2008). Integrating Sustainability Practices Using the Viable System Model. *Systems Research and behavioral Science , 25* (5), 643-654.

Mills, J. (n.d.).

Morgan, G. (1997). *images of organization.* London: Sage.

Morlidge, S. P. (2009). Money, Time and Variety Engineering: The Application of Cybernetics to the Diagnosis and Design of Financial Performance Management Systems. *Systemic Practice and Action Research , 22* (4), 235-247.

Qiu-yan, Z., Gang, Q., & Xiao-na, B. (2007). Application of Managerial Cybernetics in Interorganizational Coordination in Condition of Environmental Uncertainty: An Empirical Study. *International Conference on Management Science & Engineering*, (pp. 566-570).

Ríos, J. P. (2006). Communication and information technologies to enable viable organizations. *Kybernetes , 35* (7/8), 1109-1125.

Rozenkranz, C., & Holten, R. (2010). The variety engineering method: analyzing and designing information flows in organizations . *Information Systems and E-Business Management , 9*, 11-49.

Schwaninger, M. (2003). A cybernetic model to enhance organizational intelligence. *Systems Analysis Modelling Simulation , 43* (1), 53-65.

Schwaninger, M. (2006). Design for viable organizations: The diagnostic power of the viable system model. *Kybernetes , 35* (7/8), 955-966.

Schwaninger, M. (2005). *Intelligent organizations.* Springer.

Schwaninger, M. (2000). Managing Complexity—The Path Toward Intelligent Organizations. *Systemic Practice and Action Research , 13* (2), 207-241.

Schwaninger, M. (2004). Methodologies in Conflict: Achieving Synergies Between System Dynamics and Organizational Cybernetics. *Systems Research and Behavioral Science , 21*, 411-431.

Schwaninger, M. (2004). What can Cybernetics Contribute to the Conscious Evolution of Organizations and Society? *Systems Research and Behavioral Science , 21* (5), 515-527.

Schwaninger, M., & Koerner, M. (2004). City planning "Dissolving" urban problems insights from an application of management cybernetics. *Kybernetes , 33* (3/4), 557-576.

Snowdon, R. A., Warboys, B. C., Greenwood, R. M., Holland, C. P., Kawalek, P. J., & Shaw, D. R. (2007). On the Architecture and Form of Flexible Process Support. *Software Process: Improvement and Paractice , 12* (1), 21-34.

Takahashi, S. (2006). Agent-based Organizational Cybernetic Approach to Organizational Learning. *SICE-ICASE International Joint Conference*, (pp. 4591-4595). Busan.

Tejeida-Padilla, R., Badillo-Piña, I., & Morales-Matamoros, O. (2010). A systems science approach to enterprise resources planning systems. *Systems Research and Behavioral Science , 27* (1), 87-95.

UÇAK, H., & Berk, A. (2009). *Structural change in turkish agricultural insurance policy and recent developments.*

Vidgen, R. (1998). cybernetics and Business Processes: Using the Viable System Model to Develop an Enterprise Process Architecture. *Knowledge and Process Management , 5* (2), 118–131.

Warren, K. (2008). *Strategic management dynamics.* John Wiley and sons.