Abstract  Redesigning managerial structure and redefining managerial processes in a large supply chain network in national scale is the main focus in this study. The considered supply chain is mainly under governmental management. Reducing the role of the government in managing the supply chain is a strategy pursued in this study. The supply chain is approached as a socioeconomic system and a methodology is designed to address important aspects of the system. The methodology is divided into two streams addressing two main aspects of a socioeconomic system—functional and social. Organizational cybernetics is the core of functional stream. The SCOR model has been used as a well-accepted supply chain management tool alongside the viable system model. The Social stream benefits from ideas of the methods which are used in the soft systems methodology and interactive planning. The methodology is applied in the considered supply chain network in which the final product is chicken meat. While supply chain management is mostly approached from a functional viewpoint, this study also considers its social aspects. Using soft methods as well as functional methods result in a systemic design which is functionally and socially desirable.

Keywords  Organizational cybernetics · The viable system model · Democratic hierarchy · Supply chain management · Soft systems approach

Introduction

Socioeconomic systems are essential entities in societies which have important effects on the communities’ social and economic situation. Managing the systems requires proper management systems taking advantage of advanced methods which are capable of handling their variant dimensions whether functional or social. Systems thinking acknowledging different aspects of socioeconomic systems provides relevant techniques and models. Supply chains and industries are an instance of socioeconomic systems which
affect a country’s economy significantly. The aim of this study is to redesign the managerial system of a large supply chain network by use of systems models. The considered supply chain is mainly under governmental management. Reducing the role of the government in managing the supply chain is a strategy pursued in this study. The supply chain is approached as a socioeconomic system and a methodology is designed to address important aspects of the system. The methodology is divided into two streams addressing two main aspects of a socioeconomic system—functional and social. Application of the methodology is shown in a case study of a large chicken meat supply chain network which includes the broiler industry. Applied systems thinking includes various methodologies and methods each of them suitable for a specific kind of problems (Jackson 2003). Organizational cybernetics among functionalist approaches is considered as the core of functional stream because of its power in organizational systems diagnosis and design. Two soft methods which are used in Checkland’s soft systems methodology and Ackoff’s interactive planning are utilized in the social stream.

Literature Review

Systems thinking was emerged in late 1940s and 1950s. Von Bertalanffı 1950, 1968 and Wiener (1948) popularized systems thinking and formed it as a discipline. After that systems methodologies were developed to implement systems principles and concepts in real world situations (Jackson 2003). Various systems methodologies are applicable to determined and restricted kinds of systems in restricted kinds of problem situations since they pertain to determined social paradigms (Jackson 2003). There are four social paradigms dominating systems thinking—functionalist, interpretive, emancipatory and postmodern (Jackson 2000). Functionalist paradigm aims at ensuring well-functioning of the system. The interpretive paradigm explores 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. The postmodern paradigm encourages variety and diversity to raise conflicts and emphasizes having fun. Organizational cybernetics is a functionalist systems methodology which uses cybernetic laws and ideas from neurophysiology to describe viable systems (Beer 1979, 1981, 1985). The viable system model (VSM) describes the features of a system which can remain viable in a turbulent environment. VSM is in heart of organizational cybernetics and a powerful tool for diagnosing existing systems or designing new ones. Organizational cybernetics has been used in diverse contexts such as information systems and knowledge management (Schuhmann 1990; de Raadt 1990; Kovacheva 2006; Takahashi 2006; Rı´os 2006; Rozenkranz and Holten 2010), Social, behavioural and organizational context (Schwaninger 2003; Achterbergh et al. 2003; Fransoo and Wiers 2005; Assimakopoulos and Dimitriou 2006), Business process management (Vidgen 1998; Di Mascio 2002; Snowdon et al. 2007; Azadeh et al. 2012), Environmental management (Lewis 1997; Lewis and Stewart 2003), Project management (Britton & Parker 1993), Performance management and auditing (Espejo et al. 2001), Planning theory (Schwaninger 1990), Risk analysis (Foster 1997), Distribution and sales (Benton & Kijima 1998), Financial and budgetary (Morlidge 2009), Production management systems (Tejeida-Padilla et al. 2010).

Flood and Jackson (1991) discussed combinatorial use of systems methodologies because they complement each other and it would be possible to cover different aspects of a system in a problem situation in this way. The need to combine systems methodologies and methods was gradually more acknowledged. Schwaninger (1997) introduced a new
methodological framework, named integrative systems methodology in which different methodologies were synthesized to overcome their respective limitations. Various authors have used different systems methodologies or methods in combination in different contexts. Organizational cybernetics has also been used in combination with other methods and models. Schwaninger (2004) discusses using system dynamics with organizational cybernetics to achieve a synergy between them. Ríos (2006) presented VDMod as a software tool for combinatoiral use of VSM with other systems methodologies especially system dynamics. Jones et al. (2007) adopted a cybernetics approach to multi-agent simulation of society. The VSM is used as a framework for the simulation. Clemens (2009) used scenario orientated narratives and risk assessment frameworks with VSM for scenario planning and environmental scanning in a public sector. Kinloch et al. (2009) used the VSM with soft systems methodology to support crime detection and operational planning in the UK police force. Donaires et al. (2010) used VSM and Ulrich’s critical systems heuristics to develop a model for diagnosing a social group composed of small and medium businesses in Brazil. Azadeh et al. (2012) used discreet event simulation alongside the VSM for analyzing business processes of a high-tech company. This is the first study which uses the VSM with two soft systems methods applied to a country-level supply chain.

Research Methodology

As stated earlier, the aim of this study is to redesign the managerial system of a supply chain network which is considered as a socioeconomic system. Hence two main aspects should be incorporated—functional and social. Social aspect covers the concerns of interpretive and emancipatory paradigms. So the methodology consists of two streams covering mentioned aspects of the system—functional and social streams. Figure 1 shows
the methodology and its supporting methods. The methodology starts with identifying the current situation. Then an analysis will reveal current shortcomings and improvement needs. Having diagnosed the current situation, a new system will be proposed using various systems methods from different systems methodologies to overcome the weak points which are controllable by the managerial system. The methodology makes it possible to use different systems methods pertaining to different paradigms for improving a socioeconomic managerial system.

Functional Stream

In the functional stream a diagnosis of the supply chain is made by use of the VSM. For this purpose system elements are so identified that the VSM subsystems can be distinguished. Therefore the entities involved in the supply chain (including supply chain nodes and facilitator bodies), their tasks and processes and their relations are identified. SCOR model as an accepted tool in supply chain management literature is used for categorizing the processes. After modelling the system based on VSM in step 2, a diagnostic analysis of the situation is performed with VSM in step 3. Among all the functional weak points, some are controllable by redesigning the managerial system (i.e. redesigning the structure and redefining the processes) and some are not. New managerial system is so designed that those controllable weak points be overcome.

Social Stream

The aim of the social stream is to respond to interpretive and emancipatory paradigms concerns. Different stakeholders are identified in this regard. The supply chain has been considered as a human activity system. CATWOE and XYZ which are methods of Checkland’s soft systems methodology are used for describing engaged viewpoints towards the supply chain in the situation. The extent of stakeholder participation and the mechanisms which ensure effective stakeholder participation in decision making are identified to reveal improvement chances for stakeholders to play a proper role in system governance. Democratic hierarchy from the methodology of interactive planning in combination with VSM and SCOR model contribute to design a new supply chain managerial system which presents functional and social benefits. Table 1 shows the methodology steps, methods utilized for each step and the outputs.

Case Study: A Large Chicken Meat Supply Chain

A chicken meat supply chain including broiler industry is a socioeconomic system the product of which is one of the most important sources of protein in the world. According to international statistics production and consumption of chicken meat is increasing every year (Anon 2012). The complexity of managing chicken meat supply chains grows as a consequence of the increase in the supply chain span and therefore managerial bodies of supply chains should be upgraded if they are to be effective in managing the increasing complexity. In this case study most of managerial bodies of chicken meat supply chain network are governmental. In this situation developing the managerial body of chicken meat implies growth in governmental bodies resulting in growing the government size while downsizing the government body and transferring a huge portion of current government tasks to nongovernmental sector is an important strategy of especial importance in
| Step | Methods | Outputs |
|------|---------|---------|
| 1-1-Identifying supply chain subsystems (nodes and facilitator bodies), their tasks and relations | Studying chicken meat supply chain literature | List of supply chain nodes, their relations and recognizing different structures of supply chain existing in case situation |
| | Interviews with industry experts who work in supply chain businesses and facilitator bodies | List of facilitator bodies, their mission, processes and the relations between them |
| 1-2-Modelling the system with VSM | VSM | VSM model of the supply chain |
| 1-3-Cybernetic diagnosis | Methods and instructions of organizational cybernetics methodology | Functional shortcomings (categorized into controllable and uncontrollable by metasystemic structure) |
| 2-1-Identifying key stakeholders and their viewpoints | Interview with different stakeholders | List of key stakeholders and description of their viewpoints |
| 2-2-Interpretive and emancipatory analysis | Investigating power distribution and debate opportunities | Metasystemic social shortcomings (categorized into controllable and uncontrollable by metasystemic structure) |
| 3-Designing new managerial system for supply chain to overcome controllable shortcomings | A combination of VSM, SCOR and democratic hierarchy | New managerial system proposition |
Inevitably there is a need to redesign managerial system of chicken meat supply chain with the approach of reducing government administration in managing the supply chain. Chicken meat supply chain is constituted of various stages or nodes. Figure 2 shows a typical chicken meat supply chain constituting elements.

The supply chain starts with a line farm then comes a grandparent farm (GP) which is followed with a parent farm (P). The aim of the mentioned stages is to obtain chickens which are genetically proper for rearing as broilers. There stands broiler farm (B) after parent farm. Day-old chickens go to a broiler farm after they are hatched in a hatchery. After the chickens reach the desirable weight they are transferred to a slaughterhouse to be slaughtered. Stages of processing and distribution come after slaughtering. Feed mills, equipments manufacturers and providers of drug and additive stocks support the supply chain by respectively providing poultry feed, technological equipment, vaccine, medicine and additive stocks. Application of the methodology (Fig. 1: Research Methodology) in the chicken meat supply chain network is described in the following.

Functional Stream

Identifying Supply Chain subsystems, Their Tasks and Relations

Operational subsystems (supply chain nodes), metasystemic subsystems (facilitator bodies), their tasks and relations has been identified. The processes are categorized according to SCOR model. Supply chain nodes (Fig. 2) are the operational elements of the system which perform executive processes. Table 2 shows facilitator bodies which perform planning and enabler processes of the supply chain.

There are various possible relational patterns between supply chain nodes. When a common owner owns all nodes of a supply chain, then it is called a vertical integration. Vertical integration is the most integrated structure of a supply chain. In the other hand, independent structure is a structure in which supply chain nodes have no defined relations with each other. They procure their resources from market (not from a determined supplier) and deliver their products to the market, too. Independent structure is the most discreet structure of a supply chain. Investigating different supply chain structures in the case situation, it was found that in spite of existing variant supply chain structures, independent structure is dominant on the supply chain network. Consequently, intermediate markets are the dominant link between subsequent nodes in supply chain.
| Metasystemic subsystem                  | Task                                                                 | Corresponding process in SCOR model |
|----------------------------------------|----------------------------------------------------------------------|------------------------------------|
|                                        |                                                                      | Level 0                            |
|                                        |                                                                      | Level 1                            |
|                                        |                                                                      | Planning                           |
|                                        |                                                                      | Enabler                            |
| Ministry of Agriculture                |                                                                      |                                    |
| Animal affairs deputy                  |                                                                      |                                    |
| Poultry office                         |                                                                      |                                    |
| Broiler group                          | Annual planning for chicken meat production                       | Supply chain                       |
|                                        | Controlling the production capacity of the industry (licensing)     | Source, make                       |
|                                        | Long term planning for the industry                                 | Source, make                       |
|                                        | Defining industry improving projects                                | Supply chain                       |
|                                        | Policy making                                                       | Supply chain, source, make         |
| Veterinary                             |                                                                      |                                    |
| Poultry office                         | Controlling sanitary performance of farms                          | Source, make                       |
|                                        | Controlling epidemics (with assistance of quarantine office)         | Source, make                       |
|                                        | Obliterating sick chickens                                          | Source, make                       |
|                                        | Policy making                                                       | Source, make                       |
| Public healthcare office               | Giving sanitary instructions                                        | Source, make, deliver              |
|                                        | Controlling sanitary performance of distribution centres            | Deliver                            |
| Quarantine office                      | Controlling epidemics                                               | Source, make                       |
|                                        | Monitoring epidemics inside the country and abroad                  | Supply chain                       |
|                                        | Controlling animal entrance in the borders                          | Supply chain                       |
| Animal Sciences Research Institute     | Doing research                                                      | Source, make                       |
| (ASRI)                                 |                                                                      |                                    |
| Ministry of Trade                      |                                                                      |                                    |
| Market regulation committee            | Controlling the market (chicken meat sales price)                   | Deliver                            |
|                                        | Policy making                                                       | Deliver                            |
| Trade promotion organization           | Developing foreign trade                                            | Deliver                            |
| Financial, credit and insurance       |                                                                      |                                    |
| institutions                           |                                                                      |                                    |
| Bank of Agriculture                    | Financial support                                                   | Source, make                       |
| Agricultural Insurance Fund (AIF)      | Insuring chickens with governmental subsidies                       | Source, make                       |
| Institute of Standard and Industrial Research | Setting standards                                | Source, make, deliver              |
|                                        | Auditing businesses conformance to defined standards                | Source, make, deliver              |
Modelling the System with VSM

After defining system objectives, the first step in modelling the system with VSM is identifying system hierarchy or recursion levels (unfolding complexity). Administrative structure of the supply chain and syndicates can illustrate the way system recursion levels have been defined in current situation. Figure 3 shows the hierarchy.

A supply chain may cross some economical sections. Chicken meat supply chain is the case. It crosses several economical sections as shown in Fig. 4. Hence coherent management of the supply chain requires crossing existing administrative boundaries.

Figure 5 shows the VSM applied to the broiler industry. Businesses constitute system1 elements. Generally the businesses involve one or more of the supply chain nodes. As stated earlier in the case situation most of businesses involve one node of supply chain.

As shown in Fig. 5 there are two metasystemic organizations in the level of the broiler industry: broiler group of poultry office in animal affairs deputy; and broiler group of poultry office in veterinary both of which belong to the Ministry of Agriculture. Figure 6 shows metasystemic bodies of three recursion levels. Table 3 shows metasystemic
Fig. 4 Chicken meat supply chain crosses several economical sections

Fig. 5 The VSM applied to the broiler industry
organizations, their recursion levels and the VSM subsystem to which they have a contribution. Recursion levels higher than “000” (level of agriculture) have been considered as environmental entities.

**Cybernetic Diagnosis**

Cybernetic diagnosis has been performed with broiler industry as the system in focus or system level 1. The main detected weak points are as follows.

1. **Weak point 1** According to organizational cybernetics, viability of operational elements is a precondition for system viability. In the case situation the businesses which constitute system1 elements lack requisite viability. There are a high number of smallholders with insufficient financial and technical bases. Rate of bankruptcy is high in the supply chain;

2. **Weak point 2** The dominant structure of supply chain network which constitutes the structure of system1 is inherently high-variant. The independent structure of the supply chain causes most of businesses to be dependant to other businesses while in this structure the linking channel between businesses are intermediate markets.

Fig. 6 VSM applied to three recursion levels of the system
As a consequence system2 faces too high variety to handle; oscillation and bull-wipe effect are frequent events in the supply chain network;

(3) **Weak point 3** High number and dispersion of businesses cause the metasystem to face too much variety. For example veterinary can’t apply sufficient control on businesses to ensure application of sanitary instructions. In fact there is a missing recursion level between recursions 1 and 2. Syndicates could act as intermediate managerial bodies between the government and businesses. Figure 7 illustrates how an intermediate level has been missed. As shown in the figure, the metasystem has to control performance of businesses in addition to the performance of supply chain;

(4) **Weak point 4** There is a lack of coordination between production capacities of different stages in the supply chain. For example total production capacity of slaughter houses is higher than total broiler production capacity in broiler farms. Hence there is an imbalance between demand and supply in the intermediate market between the two mentioned stages;

(5) **Weak point 5** There are some coordination mechanisms like standards for intermediate products of supply chain, defined by system2. However there is no guarantee for their application since system3* has no mechanisms for controlling businesses. The weak point is a consequence of that mentioned earlier—high variety of system1, high number and dispersion of businesses;

(6) **Weak point 6** There are multiple organizations in the metasystem which are not well-coordinated. Each of performance measures of the supply chain (chicken meat price, quality and production quantity) are monitored and controlled by different organizations. Businesses face conflicting policies which threatens system stability;

(7) **Weak point 7** Beer emphasizes effective dialogue and reaching consensus between the metasystem (especially system3—control) and system1 (operations) elements. Lack of mutual understanding, and the sense of belonging being absent between

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**Table 3** Metasystemic elements, their recursion level and roles in the VSM

| Organization                               | Recursion level | VSM subsystem |
|--------------------------------------------|-----------------|---------------|
| Ministry of Agriculture                    | 000             | 5             |
| Animal affairs deputy                      | 00              | 5             |
| Nutrition office                           | 00              | 3             |
| Poultry office                             | 0               | 3             |
| Broiler group                              | 1               | 2, 3, 4, 5    |
| Veterinary                                 | 00              | 5             |
| Poultry office                             | 0               | 3             |
| Broiler group                              | 1               | 3, 3*         |
| Public health office                       | 00              | 2, 3*         |
| Quarantine                                 | 00              | 4             |
| Animal Sciences Research Institute         | 00              | 4             |
| Ministry of Trade                          | Environmental   | 5             |
| Market regulation committee                | 00              | 3             |
| Trade promotion organization               | Environmental   | 4             |
| Bank of Agriculture                        | 000             | 3             |
| Agricultural Insurance Fund (AIF)          | 000             | 3             |
| Institute of Standard and Industrial Research | Environmental | 2, 3*     |
metasystem and businesses make it impossible for them to reach an effective dialogue. It is illustrated in social stream that the two possess fully different viewpoints and approaches in their activities in the supply chain;

(8) **Weak point 8** There is no ultimate authority to integrate metasystemic organizations and assess their performance;

(9) **Weak point 9** Many metasystemic processes are performed by very high-level organizations which have little concentration on the broiler industry (like codifying standards by the Institute of Standard and Industrial Research which is an environmental organization; or market regulation by market regulation committee which is two levels higher than the recursion level of the industry). It threatens conformance with Ashby’s law of requisite variety.

**Social Stream**

**Identifying Key Stakeholders and Their Viewpoints**

As Ackoff (1981) stated a system should meet three kinds of objectives to remain viable in the systems age—objectives of the system itself, objectives of wider system and objectives of the subsystems. According to Ackoff and interviews with broiler industry experts, there can be three viewpoints and three main stakeholders detected in the situation. Since the supply chain can be conceived as a human activity system (Checkland & Scholes 1990), the viewpoints are described using Checkland’s CATWOE and XYZ guidelines in the following.
(1) The viewpoint of providing food security:

Broiler supply chain is a system to produce chicken meat with suitable price and quality and in sufficient quantity by internal production in order to provide the food security of the nation

Customer: chicken meat consumers and the government
Actor: the businesses (producers, distributors, etc.)
Transformation: need to chicken meat → satisfied need
Owner: the regulator bodies (mainly the government in current situation)
Worldview: food security of the nation is very important and must be pursued seriously. Ensuring food security is a duty of the government
Environmental constraints: constraints of natural and financial resources

(2) The viewpoint of profitability and creating wealth:

Broiler supply chain is a system to make income and profit by production and distribution of chicken meat in order to create wealth.

Customer: investors and the employed in the supply chain
Actor: investors and the employed in the supply chain
Transformation: existing wealth → higher wealth
Owner: the regulator bodies (mainly the government in current situation)
Worldview: broiler supply chain is an opportunity for creating wealth
Environmental constraints: constraints of natural and financial resources, constraint of chicken meat demand.

Another viewpoint which is less prioritized than the others is that the broiler supply chain is an instrument for implementing the government strategies and policies. Instances of the viewpoint would alter with the government strategies being changed. In the current situation increasing employment rate with small-size businesses is the instance of the viewpoint:

(3) The viewpoint of increasing employment rate:

Broiler supply chain is a system to increase rate of employment by creating small-size businesses in order to decrease unemployment

Customer: the unemployed and the government
Actor: the government
Transformation: the unemployed → employed
Owner: regulator bodies (mainly the government in current situation)
Worldview: increasing employment rate is one of the priorities of the government. The agriculture section is a suitable context for the purpose
Environmental constraints: constraints of developing the employment such as limits of the government budget, natural and land resources constraints

The first viewpoint is usually found in the consumers and governmental bodies, the second mainly belongs to the investors and the employed in the supply chain, the third viewpoint belongs to the government. So there can be three main stakeholder groups distinguished:

- Supply chain customers (the people);
- Investors and the employed in supply chain;
- Governmental bodies.
Interpretive and Emancipatory Analysis

Interpretive systems thinking seeks to explore goals and objectives that different stakeholders bring to their activities. It concerns to ensure an effective dialogue among stakeholders. In preceding section interpretive tools were used to describe different viewpoints in chicken meat supply chain. In other words three different sources of defining goals and objectives for the supply chain were described—the private sector, the government and the customers. As shown in functional stream, private sector has no serious role in managing the supply chain while over 90% of businesses belong to the private sector. Having investigated managerial processes there were few metasystemic processes assigned to the private sector (for example the syndicates) and in some processes that the private sector was involved alongside the governmental bodies, no mechanisms ensuring consideration of the private sector opinions and application of them were found. The managerial structure of the supply chain described in functional stream shows the concentration of power in just one stakeholder group. Businesses and customers have no power in managing the supply chain. Hence the structure of the supply chain needs a reform from the interpretive and emancipatory viewpoints.

Designing New Managerial System for the Supply Chain Network

Having done the functional and social diagnosis, the new managerial system should be such designed that existing weak points are overcome as much as possible. It is noteworthy that not all of weak points are controllable by redesigning managerial structure and processes. Table 4 shows how each controllable weak point has been addressed in the study.

According to the solutions for the weak points (Table 4), required actions for redesigning the managerial structure of chicken meat supply chain are as follows:

- To define a recursion level between broiler industry and businesses using SCOR model (Fig. 8); in fact the businesses perform executive processes of source, make and deliver recursion levels. Metasystems should be designed for performing corresponding planning and enabler processes;
- To assign responsibility of metasystemic (planning and enabler) processes of the new recursion level to syndicates;
- To delegate the responsibility of metasystemic (planning and enabler) processes of broiler industry to syndicates;
- To apply the structure of democratic hierarchy to organizations engaged in supply chain management;
- To define the stakeholders for being involved in the managerial structure.

Figure 9 shows the hierarchy of proposed structure. According to democratic hierarchy a board should be assigned to each manager consisting of immediate superior and subordinates of that. The corresponding boards are as shown in Table 5.

Similar boards are defined for lower level syndicates. Association of Broiler Supply Chain and its corresponding board (Board of Chicken Meat Supply Chain) constitute the metasystem of chicken meat supply chain and should perform planning and enabler processes for the supply chain (Fig. 10). The following constitute the metasystem of “source” recursion level and should perform planning and enabler processes for the section (Fig. 11).
Table 4  Weak points and solutions for controllable ones

| Weak point | Controllable | Uncontrollable | Solution |
|------------|--------------|----------------|----------|
| Weak point 1: non-viability of businesses | ✓ | – | Considering an intermediate managerial layer between the governmental bodies and supply chain businesses which is defined using SCOR model |
| Weak point 2: domination of independent structure on supply chain network | ✓ | – | |
| Weak point 3: missing a recursion level between the governmental bodies and businesses | ✓ | | |
| Weak point 4: lack of coordination between production capacities of different stages in the supply chain | ✓ | – | |
| Weak point 5: not working auditing processes to ensure conformance to standards | ✓ | | Considering audit processes—solving the problem of weak point 3 can lessen this problem |
| Weak point 6: multiple uncoordinated metasystemic organizations | ✓ | | 1. Establishment of an ultimate authority in the level of chicken meat supply chain  
2. Using Ackoff’s circular organization ideas—establishing a board for any manager that immediate superior and subordinates of the manager are members of that board |
| Weak point 7: lack of mutual understanding and the sense of belonging between metasystem and businesses | ✓ | | Assigning metasystemic tasks to syndicates and associations of businesses |
| Weak point 8: non-existence of an ultimate authority in supply chain to integrate metasystemic organizations and assess their performance | ✓ | | Establishment of an organization as the ultimate authority of the supply chain |
| Weak point 9: performing some of metasystemic processes in higher levels of recursions. It may come in major contrast with Ashby’s law of requisite variety | ✓ | | Assigning the processes to the organizations which are to be established in new recursion level |
| Weak point 10: concentration of power in hands of one group of stakeholders—not all voices are heard | ✓ | | Using Ackoff’s ideas of democratic hierarchy (or circular organization)—Involving all stakeholders in the boards of managers |

- Syndicate of Broiler Industry Suppliers and its corresponding board
- Syndicate of Day-Old Chicken Producers and its corresponding board
- The following constitute the metasystem of “make” recursion level and should perform planning and enabler processes for the section (Fig. 12).
- Syndicate of Broiler Producers and its corresponding board
The following constitute the metasystem of "deliver" recursion level and should perform planning and enabler processes for the section (Fig. 13).

- Syndicate of Industrial Slaughterhouses
- Syndicate of Chicken Meat Wholesalers and Retailers

Table 6 shows planning and enabler processes and their owners for supply chain level in proposed structure. The logic of VSM is used to detail planning and enabler processes. There are similar processes for source, make and deliver levels.

Fig. 8 Comparison of current and proposed hierarchies

Fig. 9 The hierarchy of proposed structure

- The following constitute the metasystem of “deliver” recursion level and should perform planning and enabler processes for the section (Fig. 13).
- Syndicate of Industrial Slaughterhouses
- Syndicate of Chicken Meat Wholesalers and Retailers
Table 5 Boards and their members

| Board                        | Corresponding organization                        | Members                                                                 | Descriptions                                                                                       |
|------------------------------|-------------------------------------------------|------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| Board of Broiler Supply Chain| Association of Chicken Meat Supply Chain         | 1. Manager of the association                                          | The customers representative is a member of agriculture commission in the parliament               |
|                              |                                                  | 2. External stakeholders (customers representative and the government representatives) |                                                                                                  |
|                              |                                                  | 3. Manager of Syndicate of Broiler Industry Suppliers                   |                                                                                                  |
|                              |                                                  | 4. Manager of Syndicate of Day-Old Chicken Producers                   |                                                                                                  |
|                              |                                                  | 5. Manager of Syndicate of Broiler Producers                           |                                                                                                  |
|                              |                                                  | 6. Syndicate of Industrial Slaughterhouses                            |                                                                                                  |
|                              |                                                  | 7. Manager of Syndicate of Chicken Meat Wholesalers and Retailers      |                                                                                                  |
| Board of Broiler Industry Suppliers | Syndicate of Broiler Industry Suppliers | 1. Manager of the syndicate                                             |                                                                                                  |
|                              |                                                  | 2. Manager of Association of Broiler Supply Chain                      |                                                                                                  |
| Board of Day-Old Chicken Producers | Syndicate of Day-Old Chicken Producers          | 1. Manager of the syndicate                                             |                                                                                                  |
|                              |                                                  | 2. Manager of Association of Broiler Supply Chain                      |                                                                                                  |
|                              |                                                  | 3. Line, GP, P farms and hatcheries representatives                   |                                                                                                  |
| Board of Broiler Producers   | Syndicate of Broiler Producers                  | 1. Manager of the syndicate                                             |                                                                                                  |
|                              |                                                  | 2. Manager of Association of Broiler Supply Chain                      |                                                                                                  |
|                              |                                                  | 3. Broiler farms representatives                                      |                                                                                                  |
| Board of Industrial Slaughterhouses | Syndicate of Industrial Slaughterhouses  | 1. Manager of the syndicate                                             |                                                                                                  |
|                              |                                                  | 2. Manager of Association of Broiler Supply Chain                      |                                                                                                  |
|                              |                                                  | 3. Slaughterhouses representatives                                     |                                                                                                  |
| Board of Chicken Meat Wholesalers and Retailers | Syndicate of Chicken Meat Wholesalers and Retailers | 1. Manager of the syndicate                                             |                                                                                                  |
|                              |                                                  | 2. Manager of Association of Broiler Supply Chain                      |                                                                                                  |
|                              |                                                  | 3. Chicken meat wholesalers and retailers representatives              |                                                                                                  |

Conclusion

Socioeconomic systems involve different aspects and dimensions. The variety of the system grows with the growth in its dimensions. For example the variety of a machine with
Fig. 10 Proposed metasystem for chicken meat supply chain

Fig. 11 Proposed metasystem for source recursion level
1,000 parts (1,000 subsystems) is less than that of a family with three members (three subsystems) since the family has a social dimension in addition to its functional dimension. The family is more complex than the machine. According to Ashby’s law, only variety can absorb variety. Hence managing a system with variant dimensions demands methods...
Table 6 Some of planning and enabler processes, their corresponding VSM function and their owners in the proposed structure

| Process processes                                      | Corresponding VSM function | Process owner                                      |
|--------------------------------------------------------|----------------------------|----------------------------------------------------|
| Planning                                               |                            | Level 1                                            | Level 2                                           |
| Production planning for supply chain                   | System3                    | Board of Broiler Supply Chain                      |
| Resources planning                                     | System3                    | Board of Broiler Supply Chain                      |
| Designing information systems which connect source, make and deliver sections | System2                    | Association of Broiler Supply Chain                |
| Strategic planning                                     | System4                    | Board of Broiler Supply Chain                      |
| Designing supply chain network structure                | System4,5                  | Association of Broiler Supply Chain                |
| Designing control mechanisms and managerial structures of the supply chain | System4,5                  | Association of Broiler Supply Chain                |
| Enabler processes                                       |                            | Level 1                                            | Level 2                                           |
| Coordination of source, make and deliver capacities     | System2                    | Association of Broiler Supply Chain                |
| Determining required rules and protocols for the supply chain | System2                    | Association of Broiler Supply Chain                |
| Determining required standards for the supply chain     | System2                    | Association of Broiler Supply Chain                |
| Gathering required data of the supply chain and analyzing them | System2                    | Association of Broiler Supply Chain                |
| Allocating resources to source, make and deliver sections | System3                    | Association of Broiler Supply Chain                |
| Performance assessment and control of source, make and deliver sections | System3                    | Association of Broiler Supply Chain                |
| Judgement and conflict resolution between businesses belonging to different sections among source, make and deliver | System3                    | Association of Broiler Supply Chain                |
| Monitoring and predicting environmental trends like grains market, poultry diseases in other countries, chicken meat consumption, etc. | System4                    | Association of Broiler Supply Chain                |
| Developing environmental relations such as marketing in foreign countries, making connections with academic organizations (e.g. universities), etc. | System4                    | Association of Broiler Supply Chain                |
| Continuous study and diagnosis of the supply chain to detect its weak points | System4                    | Association of Broiler Supply Chain                |
| Research                                               | System4                    | Association of Broiler Supply Chain; Association of Broiler Supply Chain (in collaboration with Animal Sciences Research Institute) |
| Performing developing projects                         | System4                    | Association of Broiler Supply Chain; Association of Broiler Supply Chain |
| Performance assessment of managerial organizations of the supply chain | System5                    | Association of Broiler Supply Chain; Board of Broiler Supply Chain also monitors the association performance |
capable of handling all the dimensions. Combining different models and methods can provide required variety to cope with different dimensions of a socioeconomic system.

Supply chains are not just economic but socioeconomic systems. Especially in national scale they have significant effects on economic and social situation of the country. Systems methodologies pertaining to various paradigms make it possible to address different aspects of a supply chain. This work provides social as well as functional insights into the problem of supply chain governance and management. The methodology of organizational cybernetics and methods of soft systems methodology and interactive planning are used in this study. SCOR model as a well-known supply chain management tool is used alongside the VSM. Combination of the VSM, SCOR model and democratic hierarchy creates a strong structure for managing the supply chain in a coherent manner in national level. The structure has advantages covering the shortcomings of current situation. It is noteworthy that the new structure is designed under the constraints of uncontrollable weak points (like the independent structure of the supply chain). If there was the possibility of intervening in other weak points, it would be possible to propose a simpler structure than that proposed.

There are two main contributions in the study:

- Designing a socio-functional methodology for redesigning managerial and governance structure of supply chains especially those in country-level. The methodology may be applied in other supply chains and even other socioeconomic systems with methods suitable for the case situation.
- Utilizing various systems methods in analyzing the supply chain and combining functional and soft systems methods to design a managerial system for that.

The effects of the operations (system1) structure on the metasystem structure can’t be overlooked. Variety engineering not only requires amplifying the variety of the controller, but also decreasing the variety of the system under control. This study faced the constraint of operations structure. Future research may address the problem of the study without the mentioned constraint.

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