CHAPTER 5

HUMAN BODY INSPIRED MODEL OF ORGANIZATIONAL EXCELLENCE [5.1*]

5.1 Introduction

The business world is becoming increasingly dynamic and competitive. In such competitive and globalized world, redesigning the organization as per the environment is one of the preconditions for achieving performance excellence. However, redesigning organizations should inculcate all relevant aspects with due prudence. Given such conditions, it is also important for organizations to evaluate their competitive and managerial strategies on periodic basis, which is a complicated and tedious task. Such evaluation would help organizations in indentifying the key focus areas for attending quality and continuous improvement of performance. In this regard, many organizations have adopted business excellence models. Such models promote adoption of best practices and tools that allow adopting the quality strategy for benchmarking of best practices, self assessment and continuous improvement. Moreover, every organizational excellence model considers certain set of principles, criteria and approaches that facilitate achievement of best results in long term, and therefore providing support to sustainable development [283]. A number of business models are available in literature for evaluating organizational excellence, all having their own advantages and limitations but none of them is addressing all issues. But all business excellence models or national quality awards (EMs/NQAs) have one thing common i.e. aim of establishing guidelines and criteria for evaluation and improvement towards organizational excellence, both at national and international levels [391]. According to Khoo and Tan [184] the most popular EMs/NQAs which are widely used by organizations for self-assessment and improvement are the Malcolm Baldrige National Quality Award (MBNQA) in the USA, the Deming Prize in Japan, the European Excellence Award based on the EFQM Model, the Singapore Quality Award, and the Australian Business Excellence

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Award [330]. These models are dynamic in nature and undergo regular review and modification [283].

Nevertheless, when these awards have been compared, significant similarities were found in terms of their mission, core values, concepts, criteria and items used for assessing award applicants. The exception is that how each award deals with new trends such as knowledge, technology, innovation management, etc. Moreover, there are several limitations with the existing award models. The organizations which have implemented the existing BEMs claim that they are essentially non-prescriptive frameworks designed mainly for assessment of award applications and therefore they do not provide specific guidelines for management control. Moreover, the structure and language of existing BEM call for "expert involvement", and hence their use has become dominated almost exclusively by experts and consultants. Another argument is that despite having a holistic perspective at its conceptual level the existing models lack guidance for integration at the operational/process level [87]. In fact presence of multiple models creates competition within them which in turn encourages innovation and improvement of the models.

Therefore, considering the need for an ideal benchmark, this chapter is aimed to propose a model which benchmarks 'the human body' which has been considered as Nature's perfect creation and has been evolved to the highest level of performance excellence by continuously adjusting itself to the ever changing conditions. This would require benchmarking various elements of human body perfection. Furthermore, the process of benchmarking human body requires exploring it as an organization. It involves holistically visualizing human body as an organization and its subsystems as specialized functional units. Moreover, each human body subsystem has also been studied separately to explore and discover the specific managerial enablers, which collectively makes human body perfect. Various techniques like metaphor approach and TISM have been used to develop the model.

5.2 Objectives and techniques used

The aim of this chapter is to propose an organizational excellence model inspired from human body. The overall objective of this chapter is planned to be achieved through following sub-objectives as shown in Figure 5.1:

i. To develop analogies between the human body subsystems and organizational subsystems. ***Analogies and Metaphor Approach*** has been used to achieve this objective.

ii. To develop a model using human body organization enablers. ***TISM methodology*** has been used to develop the model and identify the crucial factors in an orderly manner.

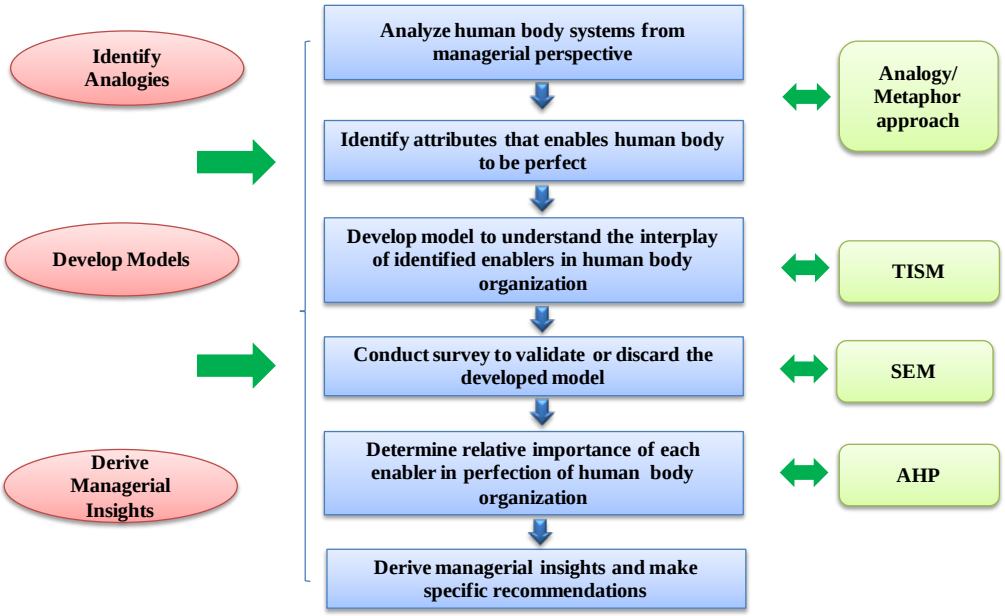

Figure 5.1: Broad steps involved in modeling with relevant technique

5.3 Identifying enablers in human body performance excellence

This section is aimed at identifying enablers in human body based on its comparison with corporate organization. This task involves the following steps:

5.3.1 Analyzing human body systems from managerial perspective

It is interesting to look at human body as an organization which is made of many cells, organized into tissues, which in turn are organized into structures called organs, which are further grouped into organ systems. This is similar to an organization which is made of people organized into work teams; similar work teams are grouped as department and so on. Also, similar to a business organization, human body is a group of subsystems which can perform functions that a single subsystem cannot perform alone. Each sub-system in both human and corporate body has a primary function and few supporting functions. Furthermore, human body obtains energy and materials by ingesting food for body repair and growth. Similar process can be observed in

organizations, where necessary resources for existence and growth are achieved by injecting financial resources through procurement of raw materials. Moreover, both the systems have a corporate brain which communicate with each part and coordinates their action. Both behave as open systems that depend on the environment for resources and continued existence.

Alma Dakaj, a management consultant, in his book 'The Company Body' has compared 11 major human body subsystems to organization subsystems [88]. These are Coordinating system, Regulating system, Processing system, Operating system, Supporting system, Advancing system, Energizing system, Defending system, Innovating system, Disruptive system and Sensory system. The current research has also attempted to compare 11 human body subsystems to major organizational elements and functional areas (Figure 5.2) which are described as follows:

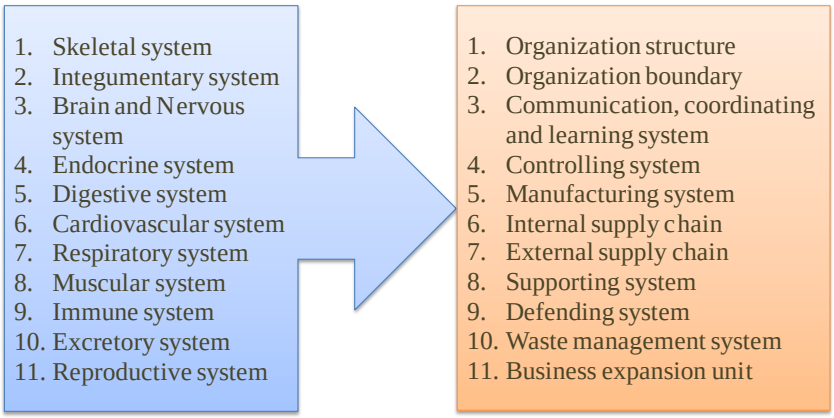

Figure 5.2: Management role performed by 11 major sub-systems in human body

5.3.1.1 Organization structure

Human body skeleton is similar to organization structure, and flesh and blood are analogous to employees manned on that structure. Similar to an organizational structure human body skeletal provides a shape to the system which facilitates *effective communication*, smooth operation of routine activities and *coordination*. Detailed study of human skeletal shows that bone and cartilage provide a strong and flexible architecture (infrastructure), attachment points facilitate movement (administration), storage of essential elements helps in formation of new products to facilitate growth and repair (R&D).

5.3.1.2 Organization boundary

The skin (sensory system) surrounding the whole body functions as system boundary. It is like a cover and is first to sense the anomalies in the environment. It integrates all the subsystems together and provides a unique identity to the system. Similar to an organizational system boundary it is porous in nature which permits the body to receive and transmit external information inside the body. Besides, the high sensory ability of the skin allows *prompt* response by human body to external stimuli.

5.3.1.3 Communication, coordination system and learning system

Brain and nervous system in human body are involved in almost its every activity. They are primarily responsible for two functions: a) communication & coordination and b) learning. Therefore the brain and nervous system has been viewed as communication, coordination and learning center.

Communication and coordination: Nervous system in human body can be modeled as a perfect communication and coordination system. It connects each and every part of human body. Also in human body coordination is inherent in every process, even the smallest unit (i.e. cell) in the body coordinates to perform its tasks. In fact every function is executed because of effective communication and coordinated effort of various subsystems. For example, whether it is physical movement, digestion/ absorption of food or breathing there is communication and coordination between various organs and organ systems. In this regard, brain can be considered as centre of coordination (top management of a business organization) which along with central and peripheral nervous system synchronizes various parts to attain the goal. This attribute in our body allows *effective communication* to take place, facilitates *coordination* and *team work* which in turn improves its *responsiveness* to external stimulus.

Learning system: Humans have a unique capacity to learn anything very quickly. Human learning system involves uninterrupted circle of old learning and new learning which keeps changing its shape in response to changing conditions. Classical conditioning is an example of learning and innovation system in our body. It involves a connection between brain centers for conditioned and unconditioned stimuli. For example, similar to changing pattern in driving to a rough road we simply adapt our actions to the road, even when we would find it more comfortable to maintain the same speed. So a sub-conscious learning allows us to adapt to the road, or we can say allows us to innovate. Moreover, we also have ability to decide which ones to select

from memory and *repeat* if successful and which ones to *discard* as unsuccessful. Such learning capacity in humans allows them to be more *adaptable* according to changing conditions. Flexibility in human body systems is a key enabler.

5.3.1.4 Controlling system

It includes the endocrine system of the human body which comprises of all glands and hormones produced by them. According to Dakaj [88] the regulating glands in our body are nothing but the people who monitor and regulate different activities and processes through hormones i.e. measurement tools and processes to maintain body's homeostasis (or business stability). Also as glands are controlled through stimulus from brain and nervous system, the regulating bodies in an organization are directly communicating with the coordination centre i.e. top management. This way controlling system in human body keeps its *processes under controlled conditions*.

5.3.1.5 Manufacturing system

In a corporate organization, manufacturing system transforms the raw material into more suitable products through its people which allows the organization to grow and survive. In human body, this is similar to conversion of food and drink into smaller molecules of nutrients so that the body can use them to provide energy. By processing important nutrients from food, the digestive system allows the human body to *survive* and *grow*.

5.3.1.6 Internal supply chain

Supply chain is vital to every business organization as the heart to human body in delivering valuable products and services (oxygen, nutrients and other essential elements in case of human body). Working processes of both involve an *in-and-out flow*. The most relevant feature of human body's supply system that allows it to deliver optimally is the position of critical supply link i.e heart in body. According to Dakaj [88], the position of heart in body is central and supported by administration staff (skeleton) and work in coordination with strategy and communication system (brain and nerves). This allows the heart to speed up and slow down the flow of exchange in different parts as instructed by brain. Presence of such robust supply chain *optimizes the supply* of all materials throughout the body.

5.3.1.7 External supply chain

External supply chain in corporate organizations is responsible for exchanging critical element like financial resources, funds, raw material, and finished goods etc. which are crucial for businesses to operate. This is analogous to respiratory system in

human body which is responsible for exchanging critical life support elements i.e. oxygen, CO_2 and other vital gases. Respiratory system in our body thus helps in *optimizing supply* of critical gases. Similarly supply of food and water from exogenous source to human body also constitutes external supply chain.

5.3.1.8 Supporting system

The muscular system in the human body can be viewed as supporting system of corporate organization. It helps the skeletal system in facilitating movement and extends load bearing capacity of the body. This is similar to support system in an organization which facilitates in execution of plans. It includes training & development department, market research team, administrative staff etc.

5.3.1.9 Defending system

Immune system in the body defends it against a variety of adverse agents like bacteria, microbes, etc. This is similar to the people and procedures defending the corporate organization from internal and external threats. Absence of such defensive mechanism in the organization may put some negative effects to its overall health like it may lead to an unhealthy workplace or loss of competitive advantage. According to Dakaj [88], unique feature of human body defending system is that, besides innate immunity, it also has acquired immunity which creates immunological memory after an initial response to specific undesired invaders and a better response to subsequent encounter with the same invaders. Such unique enabler makes the body more *adaptive* and *innovative* in managing risks. Altogether it ensures smooth operation of the body processes.

5.3.1.10 Waste management system

Renal system in our body eliminates what is no longer fit for the body (wastes). It is similar to the process of reverse supply chain in businesses and it is done by eliminating things which are no longer usable for the firm. It also involves eliminating procedures and practices that becomes outdated and unsuitable to the current era and environment. However, the unique feature of human body waste management system is that it coordinates with other functions like lungs (marketing), skin (CRM), intestines (manufacturing), and heart (supply chain). It thus maintains the *processes under controlled* conditions which ultimately uphold the *reliability* and *availability* of human body systems.

5.3.1.11 Business expansion unit

Reproductive system in human body is analogous to business expansion unit of corporate organizations. Similar to reproduction in humans wherein offspring is produced, business expansion is a strategy to achieve growth by increasing or expanding its business units.

As discussed human body subsystems jointly manages its various aspects effectively and efficiently. Examples include employee management, supply chain management, responsiveness to external environment, change management etc. Therefore we are assuming that collectively these 11 major subsystems offer the human body all those enablers that are perhaps required to manage its smooth functioning. Moreover, the above analysis has provided a base for identifying select enablers inspired from human body, which are essential in achieving organizational excellence. Such enablers are quick responsiveness to external stimuli, coordination, effective communication, optimized supply chain, innovativeness, adaptability, reliability, process control, and self driven.

5.3.2 Defining enablers of human body organization (HBO)

As already discussed each enabler in human body has been identified based on visualizing the body as a corporate organization. However, in order to get more understanding of human body organization there is a need to analyze each enabler individually. The following are the sub-variables under each identified enablers (also shown in Figure 5.3) which perhaps make human body as an excellent organization:

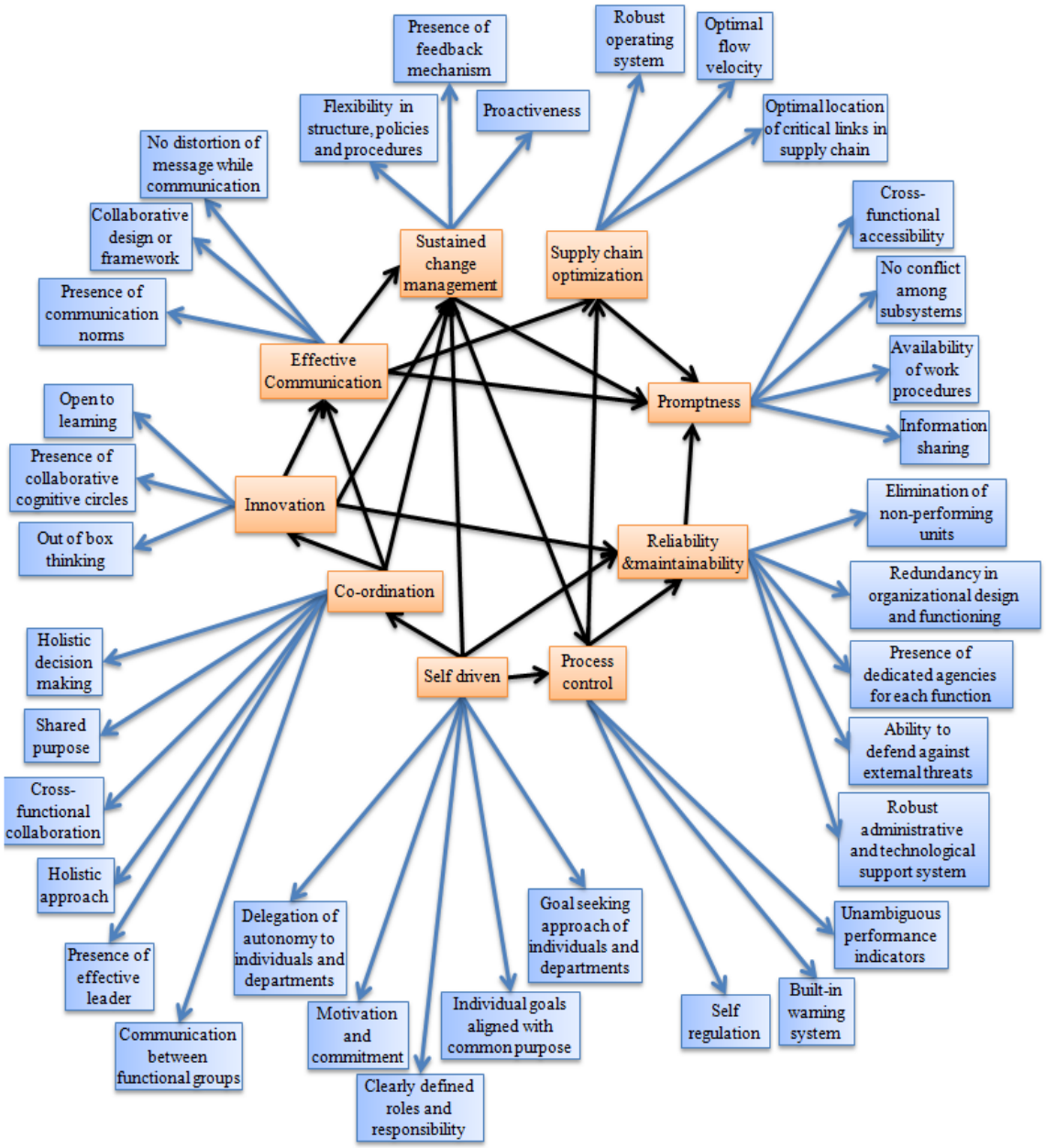

Figure 5.3: Conceptual model of excellence with variables and sub-variables

5.3.2.1 Promptness

The human body responds to stimuli very quickly by sending responses to effectors before the nerve signals reaches the conscious part of brain. For example, when some bright light is passed on the eyes, it quickly blinks without any conscious effort. The human mind without conscious thought is capable of making corrective and adaptive decisions in response to threats to its well being. Besides, human body responsiveness is not limited to external stimuli, but extended to internal parts of the

body, e.g. cellular, nervous, muscular, endocrine, and digestive system. Furthermore, specific characteristics that offer promptness to our body are summarized below.

i. *Interconnected subunits (Cross functional accessibility):* In human body, nervous system provides network of nerve cells throughout the body for conduction of signals from sensory receptors to brain and transmission of responses from the brain and spinal cord to effectors (muscle or gland cells). And the communication along such network is fast enough to keep up with the rate at which responses have to be produced to each stimulus (internal or external). Such network that relays messages back and forth from the brain to different parts of the body, allows us to quickly respond to every stimuli correctly.

ii. *No conflict among subsystems (No personal and departmental conflicts)*: Human body is free from any internal competition between its systems and subsystems. Organs of various organ systems- arms, liver, lungs, legs, heart, brain, ear, muscles, and bones- collaborate and work together while producing results. Absence of conflict of interest among the subsystems shows their motivation and willingness to contribute for larger benefit which essentially leads to higher responsiveness.

iii. *Access to predetermined instructions (Availability of SOP/ work procedures for each function):* Human body is composed of trillions of cell, each containing organism's genetic information/instructions stored as DNA. However, each cell reads only that part of a book of instructions that it needs. For example, a muscle cell uses the DNA that specifies the muscle apparatus, whereas a nerve cell uses DNA that specifies the nervous system. Such accessibility of information by each unit minimizes delays and latency in processing, speeding up the body's ability to respond.

iv. *Information sharing*: Information sharing in human body is, transmitting signals of internal and external stimulus to various parts of body. The participants do not just absorb information but interprets and passes it to other relevant participant through brain. Such active message transmission is the key factor to smooth information sharing in human body. Nervous system in our body makes such information sharing possible which speed ups the body's ability to respond.

5.3.2.2 Coordination

Various sub-systems in our body work in full harmony and coordination for achieving a definite purpose, i.e. keep the body alive. Inside human body, there is an

incredibly complicated and comprehensively coordinated network that operates twenty-four by seven. Even the smallest movements such as breathing or smiling are outcomes of perfect co-ordination inside the body. This co-ordination is particularly visible in the physical movement of the body, because, for even the smallest movement, skeletal system, muscles and nervous system must work in perfect collaboration. Detailed study of human body reveals its following characteristics contributing to body coordination:

i. *Shared purpose:* The epitome of good team work is found in the workings of the human body- a common vision or shared purpose. It is fascinating that in human body each unit is working for a common goal, i.e. healthy survival. A common purpose allows each subsystem (which plays a different role) to come together, act and react, and coordinate as one holistic group to make sure the body keeps functioning.

ii. *Interdependency (Cross functional collaboration):* Human body is a collection of 11 major sub-systems that interact together for a common purpose. Moreover, the sub-systems are related in such a way that each depends on the others to do whatever job there is to be done. No single part can do the job alone, and any malfunction or delay is likely to affect the whole body. So each part collaborates for the well being of self and the larger whole.

iii. *Holistic Approach*: In human body, holism is pursued, wherein functions and properties of the various parts and subparts, their interactions, and their relationship to the whole is considered, rather than analyzing them into parts while engaging or developing them for the well being of the body.

iv. *Presence of effective leader:* The leader in human body is not a single sub-part. Instead this function is carried out by a subsystem, which is a team in itself. It includes nervous system and brain which directs, coordinates and controls various activities in our body. The leader is interconnected with various parts to send signals in the form of order to other parts. However the results obtained are 'voluntary or involuntary action complete' depending upon the criticality of the outcome, e.g. eating and sweating respectively. So, in human body desired outcomes are achieved through coordination initiated by indirect control and orders by the leader which also contributes toward adaptation and learning process.

v. *Communication between the functional groups*: Communication between various organ systems allows them to coordinate their actions to meet the needs of the whole body. It occurs mainly through the nervous system or hormones, or directly between cells.

vi. *Holistic Decision making:* The human brain is the seat of all human decisions, thought and motivation. Brain explores all sources of information before making any decision. Human brain is wired in ways that enables it, often unconsciously, to make the best decisions possible with the information registered in its sensory circuits. Other brain cells act as the brain's "jury," compiling and weighing each piece of information. When the accumulated information reaches a critical threshold, a decision is made.

5.3.2.3 Effective Communication

In human body cardiovascular system, neural network, and endocrine system serves as vital channels of communication, exchanging chemical and electrical signals, and thus enabling health and vitality of the whole. The human body subsystems communicate primarily through molecular transactions. For example, nervous system is an ultra- large scale communication network of nerve cells, i.e. neurons, which communicates the external stimulus to brain and enables communication between different systems by conveying information with molecular impulse signals known as spike. The heart is a nano-network of muscle cells, i.e. cardiomyocytes, communicating via cardiac electric impulses, i.e. action potentials, over molecular communication channels, through the gap-junctions for continuous circulation of blood. Endocrine system, a network of glands, provides the communication among cells through specific molecular information carriers, i.e. hormones, and regulates concentrations of molecules inside the body. Moreover, following characteristics in human body facilitates occurrence of such molecular transactions for realizing effective communication:

i. *Communication norms:* Human body communication involves certain norms which are key factor to smooth communication. Such communication standards states that there should be active conversation between two subunits rather than passive message transmission.

ii. *Collaborative design or framework*: The communication channels within human body are designed holistically encompassing each member part. The design of the channel is such that the cells belonging to different sub-systems are connected to

central nervous system which functions like a network that relays messages back and forth from the brain to different parts of the body. Communication along such structure allows us to do things like walk, think, feel, be scared, and even breathe.

iii. *No distortion of message while communication:* Neurons communicate over long distances by sending signals through axons. The unique feature of human body communication system is that the original message is transmitted with no deformities. It has ability to transduce all the different languages present in the system. A stimuli or a message in human body is communicated by effective means, which is able to translate the message received into concrete action plan and transmit it through effective channels to every interacting part.

5.3.2.4 Supply chain optimization

Supply chain optimization is the application of processes and tools to ensure optimal operation of a manufacturing and distribution supply chain. This includes the optimal placement of inventory within the supply chain, minimizing operating costs (including manufacturing costs, transportation costs, and distribution costs). In human body, blood transports critical life supporting elements from the point of origin to point of consumption. Moreover, the rate and amount of blood flow to different parts of body is optimized as per their requirement. Detailed study of human body reveals the following characteristics in building an optimized supply chain in it:

i. *Robust operating system:* The circulatory system in human body serves the operating function. Its strength lies in its- reach (delivering resources to whole body), precision (delivering precise resources), time (delivering on time), continuity (regularity), distinction (between bad and good blood), and quality (delivering right quality).

ii. *Optimal flow velocity:* The amount of blood flow (transporting critical elements) to a given organ or tissue varies according to its energy requirement (and mass). E.g. Approximately 20% of the blood flowing from the heart is pumped to the brain which is about 2% of the total body mass, because the brain needs constant blood flow in order to keep up with the heavy metabolic demands of the neurons and it cannot withstand more than a few seconds of interruption of flow without loss of consciousness, and longer interruptions cause irreversible damage. Whereas the skeletal muscle, which is connected to and moves our bones so we can be active at rest, with a mass of about 30 Kg, or 40% of the body's total receives only 15% of the cardiac output. Also the rate of flow is speeded up or

slowed down in response to nerve signals from the brain. For example during exercise, metabolism speeds up and because of this the muscles require more oxygen. So the heart beats faster to supply the muscles with more oxygen-rich blood which causes an increase in speed of blood flow.

iii. *Optimal location of critical links in supply chain:* The position of heart which supplies critical life support elements is also meaningful. It lies at the center of the blood delivery system since it has to supply oxygen and collect oxygen to and from lungs, distribute nourishment from digestive system and hormones from the glands. The importance of its centrality can be justified by the need of reaching out all to organs and tissues of the organizations.

5.3.2.5 Innovation

It is the act of introducing something new or doing something in a different way. Innovation is improving the quality of the existing and eliminating redundancy or waste. It is linked with positive changes in our body like efficiency, productivity, quality, adaptability. Innovation within our body makes us inherently more adaptable to the external environment. This allows us to react faster and more effectively to avoid risk and remain healthy.

i. *Open to learning:* Human mind is inherently open to learning. We learn through two means- rational calculation (choice of alternatives based on evaluation of consequences) and learning from experience (choice of alternatives based on rules developed from past experience. So each time we experience something, we learn new out of it and alter our decisions and actions to achieve better.

ii. *Presence of collaborative cognitive circles:* Cognitive abilities are brain-based skills which we need to carry out in every task from the simplest to the most complex. Cognition includes following brain functions- perception, attention, memory, motor skills, language, visual and spatial processing, and executive functions. Furthermore, execution of each task involves collaboration of certain brain functions. For instance, simply answering a telephone call involves: perception (hearing the ring tone), decision taking- an execution brain function (answering or not), motor skill (lifting the receiver), language skills (talking and understanding language), social skills (interpreting tone of voice and interacting properly with another human being) [217].

iii. *Out of box thinking:* According to Huang [170] “Our minds are trained to operate within a 'normal' mental framework, constricting our perspectives to fit within a

defined set of standards". However, there are certain situations wherein Mind and body are in disagreement (thoughts and bodily expressions diverge) and which break unwarranted mental sets and person becomes more likely to accept and embrace atypical ideas to solve the problems.

5.3.2.6 Sustained change management

Sustained change management is adjusting or accommodating itself according to prevailing external and internal situations for long term sustainability. Human body is designed to adapt to varied adverse conditions. It readily responds to changing environmental stresses in a variety of biological and cultural ways. It can adapt to a wide range of temperature and humidity. Human body also effectively responds in physiological ways to internal and external stresses such as bacterial and viral infections, air and water pollution, dietary imbalance, and overcrowding. This ability to quickly adjust to varying environmental conditions has made it possible for humans to survive in most regions of the world. Moreover, specific characteristics that offer promptness to our body are summarized below:

i. *Flexibility:* Human body sub-systems inherently have optimal degree of flexibility to meet the functional requirement of the overall system. For example, stomach which is a distensible organ can undergo considerable expansion and can hold 2-3 litres of food. It is also capable of gross alterations in size and shape, depending on the position of the body and the amount of food inside. So optimal flexibility in human body allows it respond by altering its processes as per the situations.

ii. *Feedback mechanism*: Feedback (positive and negative) mechanisms performs the vital function of making the human body relatively insensitive to internal or external disturbances, thus enabling it to function properly in changing environment. Homeostasis mechanism in human body is responsible for feedback mechanism. For example, regulation of the amounts of water and minerals in the body (osmo-regulation), removal of metabolic waste (excretion) clot formation when a blood vessel is damaged, secretion of insulin hormone during nutrient digestion and absorption to limit the rise in blood nutrient concentration.

iii. *Pro-activeness or Feed-forward mechanism*: Human body unique ability not only lies with effectively managing change, but it also acts in anticipation of a change. In a feed-forward system, the output of one stage of the processing of the control system is sent to a later stage of the process to affect later activity. An example of a feed-forward system is the pre-adaptation for exercise, changing the activity of

postural muscles and of the vascular system in order to ready the body for the movement when it occurs.

5.3.2.7 Self driven

Self-driven means motivated to accomplish something without an external reward. Self motivation of all sub-systems collectively allows the body to become self-governing. Moreover, following attributes enhance the inherent willingness of the sub-systems to perform:

i. *Delegation of autonomy*: In human body autonomy and control are optimally balanced wherein autonomy has been delegated to voluntary activities which are guided by the mind and their cost of failure/delay is relatively low (essential for survival). Whereas brain and autonomic nervous system are in-charge of involuntary functions which are designed to occur in a reflexive manner. Their cost of failure/delay is very high (vital for survival) e.g. digestion of food, breathing, heart beating, etc. Such demarcation of activities allows delegation of autonomy which in turn makes the system self driven.

ii. *Motivation and commitment:* Brain, the leader of our body never motivates any individual cell, organ or organ system to perform. Informative signals (though neurons) are sufficient to put related subsystems on work. Self motivation or inherent willingness of all sub-systems collectively allows the body to become self-governing.

iii. *Individual goal aligned with common purpose:* In human body, goals of individual sub-systems are merged with overall purpose of body and they all work in a co-ordinate way to keep the body alive. For example nervous system is specialized to transmit signals to various parts of body and endocrine system performs regulatory function. However, both systems have common purpose i.e. to control body functions.

iv. *Clearly defined roles and responsibilities*: Multiplicity of effort in response to various stimuli is eliminated in human body by clearly defining the roles and responsibilities of the subsystems. For example, there are varieties of hormones in our body but each hormone has a unique role. Besides, when a stimulus, say for hunger, is received, only digestive hormones will be activated to coordinate the process of digestion. It is never confused with other hormones. Moreover, such clarity of roles can be seen throughout the body.

v. *Goal seeking approach*: Every single unit in human body is programmed to achieve some pre-determined outcomes within an agreed time period. In addition, human body subsystems exhibit goal seeking behavior wherein they calculate backward to obtain inputs that would result in that pre-determined outcomes.

5.3.2.8 Process control

Process control refers to the methods that are used to control process-variables when producing an outcome. In human body, maintaining a stable internal environment by providing the cells with what they need to survive (oxygen, nutrients, and removal of waste) is necessary for the well-being of individual cells and of the entire body. There are many processes by which the body controls its internal environment are collectively called homeostasis. Homeostasis in human body terminates unnecessary and unruly growth or manages to abandon the body's deviation from normal state through *feedback, feed forward and concurrent* control mechanisms. In addition, the following features in human body help achieving process control:

i. *Built-in-warning system*: The human body is a magnificent machine. When things go wrong, it generally doesn't just shut down without warning; instead it sends us little signals letting us know that something is amiss. Physical signs and symptoms are ways your body tries to alert you to deeper imbalances. For example, when the human body senses damage to tissue, it sends out biochemical messengers called histamines in response to microbial invasion. These messengers act as warning signals to the body, increasing blood flow at the site of infection, causing the capillaries to become porous allowing neutrophil white blood cells to leave the capillaries and migrate to the site of infection [152]. Moreover, there are internal warning signals too, that triggers the immune system into action when a bacterial infection is established in the body.

ii. *Self regulation (self-healing mechanisms)*: The human body is always working to maintain a state of balanced function. The human body has the ability to repair any damage that is not extensively injured beyond restoration. The secret behind is that, within the tissues, there is an inherent wisdom, a wise all-knowing restorative force, an intelligence within every cell that keeps the body well. When a state of discord arises, this healing force acts to restore functional balance and harmony. Therefore, when there is damage to the body tissues, the healthy cells from other areas, will rush to the affected part, remove the dead

cells, replace them with healthy cells and restore the part like new. As long as the agent causing the damage is removed, the obstacles to healing will be removed. For example, if there is a cut in any part of the skin with a knife, and if the damage is not serious, the body will close back the wound and repair the skin very well. All these take place without any outside assistance.

iii. *Unambiguous performance indicators*: The human body is like a complex organization that has important jobs to be done with stringent deadlines. The functional parameters of the body conform to "norms" usually expressed as a range. Such norms are the indicators of acceptable performance. When these parameters are within acceptable range the body is considered to be normal. When they are not within "norm", a signal affecting some intervention may be necessary, e.g. blood pressure, temperature, etc.

5.3.2.9 Reliability & maintainability

Reliability describes the likelihood of successful functioning of systems. Maintainability is the attribute of design which determines the probability that a failed system can be restored to its normal operable state within a given timeframe, using the given procedures and practices [305]. Human body, despite being a complex system and tolerating failures at individual subsystem level, the overall system is highly reliable. Human body is able to achieve high system reliability because it focuses on both preventing and avoiding problems in all the listed processes that might lead to an interruption of life. Also it focuses on recovering quickly and minimizing the impact from any outages that do occur. The tribute of high human body reliability & maintainability goes to following characteristics:

i. *Elimination of non performing units*: A cell is basic resource for human body, which manages its proliferation according to its requirement to the body and eliminates itself if found unfit for the role. For example, Red blood cells (RBCs) serves as oxygen carriers which is vital to the survival as it is providing life supporting element to all the other cells. However, RBCs while performing their role are subject to mechanical stress as they flow through the various blood vessels in the body undergoing tremendous wear and tear. This distortion makes it less efficient in its performance and in such a vital function; inefficiency in performance cannot be afforded by the body and therefore destroyed by themselves through cell death.

ii. *Redundancy in organizational design and functioning*: In the human body, the idea of redundancy is embedded in the form of self-organizing systems. Self-organization refers to a process whereby internal structure and functions evolve along with changing circumstances. This offers human body the ability to diagnose errors as they occur, readjust the organism to minimize the effect of errors, and correct or permanently block the faulty components. For example, when damage occurs in one part of the brain, it is common for another part of the brain to assume the functions of the damaged part.

iii. *Presence of dedicated agencies for each function*: Human body contains dedicated specialist for each and every function with which chaos is eliminated and probability of failures are reduced subsequently. For example the heart has four chambers that allow the body to send the dirty blood to the lungs and clean blood to whole body without mixing the two.

iv. *Ability to defend against external threats*: The human immune system adds reliability & maintainability of the system by creating a barrier to prevent bacteria and viruses from entering the body, by detecting and eliminating viruses or bacteria able to enter the body before they establish and reproduce, and by eliminating viruses and bacteria that enter the body and reproduce causing problems.

v. *Robust administrative and technological support system*: Skeleton system in human body serves as administrative and technological support system and contributes towards reliability & maintainability of our body. For example, articular cartilage of human skeletal system serves as shock absorber and gliding surface between the bones facilitates movement at the joint [250]. It is one of the secrets of the human body which offers reliability to it. It also provides storage to many different types of essential substances to facilitate growth and repair of the body to keep the body maintained.

5.3.3. Linking human body organization enablers to organizational context

The preceding section discussed the key enablers of human body organization. However, it is also imperative to understand the relevance of these enablers in the organizational context for its application to business organizations.

5.3.3.1 Promptness

In the world of dynamically changing business environment, companies have to deal with increasingly knowledgeable, well informed and empowered customers (and

other stakeholders) with changing demands [179]. Businesses are also confronting immense competition, shorter product life cycles, changing legal policy regulations, rapid technology change and much more. This forces the businesses to be prompt in responding to stimuli from external environment. Therefore, promptness is becoming a desirable management enabler for organizations in every management function like supply chain management [339], response to customer feedback [179], research and innovation, etc.

5.3.3.2 Co-ordination

In view of global competition, the collaborative efforts to attain shared goal is viewed as essential to organizational effectiveness and competitive advantage [133]. Moreover, modern organizations have to respond quickly, flexibly and adaptively to shifting circumstances and demands that are sometimes difficult to predict. Perhaps such situations can be addressed by combining various interrelated competencies, skills, knowledge and experiences, and through cooperation between the members of the organization [343].

5.3.3.3 Effective communication

Effective communication always plays a central role in effective and efficient management of organizations [76]. Communication creates meaning and direction for people. Lack of good communication may lead to conditions like conflicting objectives, unclear values, misunderstandings, lack of coordination, confusions, low morale and people doing the bare minimum task required [76]. Effective communication results in a shared understanding of what's most important which in turn results in achievement of desired outcomes [76].

5.3.3.4 Supply chain optimization

A noticeable shift has taken place in the market place from mass production to customized products [393]. This has resulted in the emphasis on greater organizational and process flexibility and co-ordination of process across many sites [66]. Moreover, addressing this situation primarily requires supply chain optimization [393]. Therefore supply chain management has received attention of researchers and practitioners in past few years.

5.3.3.5 Innovation

Increasing complexity and dynamism in environmental conditions and customer demand have long been forcing business firms to discover new ways of doing business by means of new tools and perspectives [14]. Due to profound changes in the

competitive environment, and emergence of new organizational forms, institutional relationships, and value-creating opportunities [150]; innovativeness has become a core talent for firms to differentiate themselves [351]. Corporations are now developing new organizational designs and human resource practices to meet such challenges [229]. According to Dunlop and Denise [109] long term sustainability depends on organizations ability to continually improve upon their competencies to find better ways of doing things. It helps in responding not only to current needs, but often anticipate future trends and develop ways to meet the future needs rapidly and effectively.

5.3.3.6 Sustained change management

Organizations today operate in an era of risk and instability. They must be prepared to respond to and manage through all of the unexpected and various disturbances it might ever encounter. Therefore the ability of companies to adapt is clearly fundamental to the strategic management literatures [91, 140, 349, 361]. Empirical evidences suggest that sustained change management is a source of competitive advantage [253]. According to Bonder [47] and Evans [115], it is the ability to identify and respond swiftly to change before it takes place, or to respond quickly once change has occurred. The main benefit of sustained change management is improved performance [50, 306]. According to Hooley et al. [166] the companies with high adaptive capability perform better than others.

5.3.3.7 Self-driven

Self driven individuals are those who can regulate their behavior on relatively whole tasks for which they have been appointed [78, 136]. They are self motivated, willing to perform and are committed to the organization. They bear ownership to the organization. They require less supervision. Despite of what else is going on; their work commitment and internal drive for results pushes them to be productive. Presence of such self motivated members contributes in effective and efficient management of organizations [212]. However, it requires greater autonomy in their day-to-day operations.

5.3.3.8 Process control

Businesses today are operating in non-stationary world and are required to be flexible. Flexibility to an optimal degree is a key to success. Thus managers must adjust the organizations' operational processes according to prevalent conditions. However, adjustment also has some acceptable limits beyond which the system

cannot accommodate [167]. Therefore organizations need control systems that can help them in maintaining their operating processes within the acceptable range.

5.3.3.9 Reliability & maintainability

Reliability & maintainability is dependent on the reliability & maintainability of that system. If an organization has low availability; the members get diverted from the mission by getting pulled back into their previous jobs or by getting assigned to other emergencies that come along. And their effort becomes diluted and progress trails [56]. Moreover, the company cannot adopt a rapid response strategy if its system is unavailable and/or unreliable. The goal of reliability & maintainability is to design, operate and improve business and operations of the system to achieve lasting organizational effectiveness and competitiveness [206]. Therefore, reliability & maintainability should be viewed as a part of corporate strategy [206].

5.4 Modeling enablers of human body excellence

Preliminary set of enablers essential for business organizations have been drawn from the above discussion. However, when all the enablers were considered independently to understand the issue, they seem equally important and in fact some appear to supersede each other. This creates a situation where it becomes difficult to have a clear and holistic view of the problem. However, by developing direct and indirect relationships and by imposing order between the enablers, the situation can be described far more accurately than by considering each enabler in isolation. This process will generate a hierarchy of enablers in the form of a framework, which will help in understanding the influence of various enablers on each other and on the problem in hand. This framework is actually a demonstration of relationship and interplay of enablers of human body organization in its effective and efficient management. Moreover, it is expected that by applying similar order in the business situation, effectiveness and efficiency in management functions can be achieved.

Hence, it necessitates selecting a methodology that can help in identifying a structure within a system, with which the problem can be articulated in a clear fashion. Purpose of developing model is to understand the enablers and their interplay that perhaps makes human body a perfect organization.

5.4.1 Methodology

The framework and methodology of Total Interpretive Structural Modeling (TISM) is used to delineate the hierarchical relationship. Experts and stakeholders

opinion from academia and industry has been sought to identify the contextual relationship among each pair of elements (enablers) and also the logic behind each relationship. For developing a TISM model for 'n' elements, an expert is supposed to define and provide reason for 'n. (n-1)' pairs of relationships [255]. The basic process of TISM followed is presented briefly in a step-by-step manner using the elements of human body organization.

Step I: Identify and define elements: The enablers derived from the analysis of human body organization, and confirmed with literature and experts' (Table 5.1) opinion have been used to identify their relationships.

Table 5.1: Enabling attributes of human body

S. No.	Enablers\ Variables	Abbreviations	Element Code
1	Promptness	PROP	E1
2	Co-ordination	COD	E2
3	Effective communication	COMM	E3
4	Supply chain optimization	SCO	E4
5	Innovation	INNO	E5
6	Sustained change management	SCNG	E6
7	Self driven	SD	E7
8	Process control	PC	E8
9	Reliability and maintainability	R&M	E9

Step II: Define contextual relationship: To develop the framework relating the elements, it is essential to define the contextual relationship between the elements [300]. Experts and stakeholders inputs are solicited to get the contextual relationship among the elements as shown in Table 5.2.

Table 5.2: Elements, contextual relationship and interpretation

Elements Code	Element Name	Contextual Relation	Interpretation
E1	Promptness	Element E1 will influence/ enhance element E2	How or in what way element E1 will influence/ enhance element E2?
E2	Co-ordination		
E3	Effective communication		
E4	Supply chain optimization		
E5	Innovation		
E6	Sustained change management		
E7	Self driven		
E8	Process control		
E9	Reliability and maintainability		

Step III: Relationship interpretation: In order to make the logic of the model more transparent and to restrict multiple interpretations by different users [319], the experts and stakeholders were asked to specify the way two elements are related.

Step IV: Pair-wise comparison: From the opinion of experts about the relationship between each pair of enablers, a matrix demonstrating presence or absence of relationship has been developed. In such matrix, for each i-j link the entry is either 'Yes (Y) or 'No (N)' depending upon the presence or absence of relationship as shown in Table 5.3.

Table 5.3: Pair-wise comparison of the enablers for effective and sustained development of organizations

Elements	E1	E2	E3	E4	E5	E6	E7	E8	E9
E1	Y	N	N	N	N	N	N	N	N
E2	Y	Y	N	Y	Y	Y	N	N	Y
E3	Y	N	Y	Y	N	Y	N	Y	Y
E4	Y	N	N	Y	N	N	N	Y	Y
E5	N	N	Y	N	Y	Y	N	N	Y
E6	N	N	N	N	N	Y	N	Y	Y
E7	Y	Y	Y	N	N	Y	Y	Y	Y
E8	N	N	N	Y	N	N	N	Y	Y
E9	Y	N	N	N	N	N	N	N	Y

Step V: Reachability matrix and transitivity check: The paired comparisons in the interpretive logic base are translated in the form of initial reachability matrix wherein '1' is assigned for 'Yes' and '0' for 'No' as illustrated in Table 5.4. This matrix is checked for the transitivity rule to achieve the final reachability matrix as shown in Table 5.5.

Table 5.4: Initial reachability matrix

Elements	E1	E2	E3	E4	E5	E6	E7	E8	E9
E1	1	0	0	0	0	0	0	0	0
E2	1	1	0	1	1	1	0	0	1
E3	1	0	1	1	0	1	0	1	1
E4	1	0	0	1	0	0	0	1	1
E5	0	0	1	0	1	1	0	0	1
E6	0	0	0	0	0	1	0	1	1
E7	1	1	1	0	0	1	1	1	1
E8	0	0	0	1	0	0	0	1	1
E9	1	0	0	0	0	0	0	0	1

Table 5.5: Final reachability matrix

Elements	E1	E2	E3	E4	E5	E6	E7	E8	E9
E1	1	0	0	0	0	0	0	0	0
E2	1	1	1*	1	1	1	0	1*	1
E3	1	0	1	1	0	1	0	1	1
E4	1	0	0	1	0	0	0	1	1
E5	1*	0	1	0	1	1	0	1*	1
E6	1*	0	0	1*	0	1	0	1	1
E7	1	1	1	1*	0	1	1	1	1
E8	1*	0	0	1	0	0	0	1	1
E9	1	0	0	0	0	0	0	0	1

Note: * indicates transitive relationships

Step VI: Partitioning the reachability matrix: The final reachability matrix obtained from step V is then partitioned into different levels on the basis of reachability and antecedents sets for each variable through a series of iterations called a level partitioning [300] (Table 5.6). The final levels achieved are shown in Table 5.7.

Table 5.6: Partitioning of the reachability matrix

Iterations	Elements	Reachability Set	Antecedent Set	Intersection	Level
Iteration 1	**E1**	1	1,2,3,4,5,6,7,8,9	1	I
	E2	1,2,3,4,5,6,8,9	2,7	2	
	E3	1,3,4,6,8,9	2,3,5,7	3	
	E4	1,4,8,9	2,3,4,6,7,8	4,8	
	E5	1,3,5,6,8,9	2,5	5	
	E6	1,4,6,8,9	2,3,5,6,7	6	
	E7	1,2,3,4,6,7,8,9	7	7	
	E8	1,4,8,9	2,3,4,5,6,7,8	4,8	
	E9	1,9	2,3,4,5,6,7,8,9	9	
	E2	2,3,4,5,6,8,9	2,7	2	
	E3	3,4,6,8,9	2,3,5,7	3	
	E4	4,8,9	2,3,4,6,7,8	4,8	
	E5	3,5,6,8,9	2,5	5	
	E6	4,6,8,9	2,3,5,6,7	6	
	E7	2,3,4,6,7,8,9	7	7	
	E8	4,8,9	2,3,4,5,6,7,8	4,8	
Iteration 2	**E9**	9	2,3,4,5,6,7,8,9	9	II
	E2	2,3,4,5,6,8	2,3,7	2	
	E3	3,4,6,8	2,3,5,7	3	
Iteration 3	**E4**	4,8	2,3,4,6,7,8	4,8	III
	E5	3,5,6,8	2,5	5	
	E6	4,6,8	2,3,5,6,7	6	

Table 5.6: Partitioning of the reachability matrix

Iterations	Elements	Reachability Set	Antecedent Set	Intersection	Level
	E7	2,3,4,6,7,8,	7	7	
Iteration 3	**E8**	4,8	2,3,4,5,6,7,8	4,8	III
	E2	2,3,5,6	2,7	2	
	E3	3,6	2,3,5,7	3	
	E5	3,5,6	2,5	5	
Iteration 4	**E6**	6	2,3,5,6,7	6	IV
	E7	2,3,6,7	7	7	
	E2	2,3,5	2,3,7	2	
Iteration 5	**E3**	3	2,3,5,7	3	V
	E5	3,5	2,5	5	
	E7	2,3,7	7	7	
	E2	2,5	2,7	2	
Iteration 5	**E5**	5	2,5	5	VI
	E7	2,7	7	7	
Iteration 6	**E2**	2	2,7	2	VII
	E7	2,7	7	7	
Iteration 7	**E7**	7	7	7	VIII

Table 5.7: Final level of elements in TISM

Element Code	Element name	Levels in TISM
E1	Promptness	I
E9	Reliability and maintainability	II
E4	Supply chain optimization	III
E8	Process control	III
E6	Sustained change management	IV
E3	Effective communication	V
E5	Innovation	VI
E2	Co-ordination	VII
E7	Self driven	VIII

Step VII: Developing a digraph: Now the elements are arranged graphically as per the levels obtained in the previous step and the directed links are drawn as per the relationships shown in reachability matrix. A simple digraph (as shown in Figure 5.4) is obtained, showing only those transitive relationships whose interpretaion is crucial.

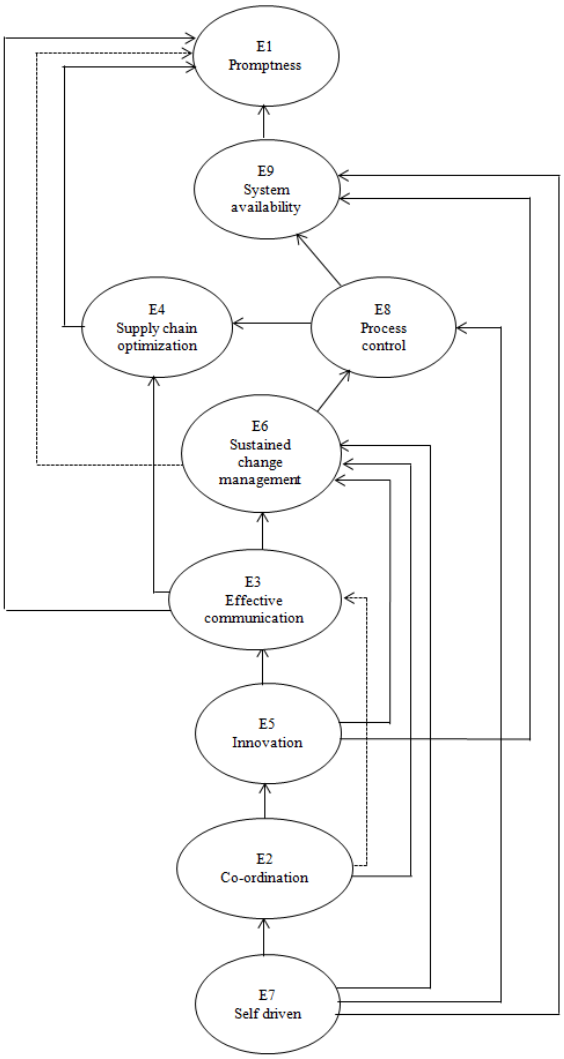

Figure 5.4: Digraph with significant transitive links

Step VIII: Interaction matrix: The final digraph is translated into a binary interaction matrix representing all the interactions by 1 entry. Then the cells with 1 entry are interpreted by picking the relevant interpretation from the knowledge base in the form of interpretive matrix as shown in Table 5.8 [320].

Step IX: Total interpretive structural model: Finally, TISM (as shown in Figure 5.5) is developed in which, links are also interpreted and the interpretation is written along the side of the respective links [320]. TISM model is finally checked for conceptual discrepancies and made necessary modifications.

Table 5.8: Interpretive matrix

Elements	Promptness	Co-ordination	Effective communication	Supply chain optimization	Innovation	Sustained change management	Self driven	Process control	Reliability and maintainability
Promptness									
Co-ordination			smoothe flow of information, reduced barriers to communication		collaborative intelligence	support and complement other's tasks which facilitates alignment to change			
Effective communication	time to transmit information is reduced			continuity, timliness & precision		allows better translation of message into concrete action plan			
Supply chain optimization	better coordination, reduced barriers							ensures supply of materials at the right time at an acceptable price	
Innovation			more rational organizational design			improves preparedness to environment		and at the desired	improves reliability & maintainability
Sustained chang management	reduced action and reaction time							a more versatile system is more efficient and better controlled	
Self driven		more positive attitude to perform and deliver				results in collective readiness to change		delivering expected performance reduces deviation	individual performance enhances consistency of successful functioning of systems
Process control				reduced deviations enhances continuity, timliness & precision					reduced variations enhances confirmance
Reliability and maintainability	improved system reliability and maintainability								

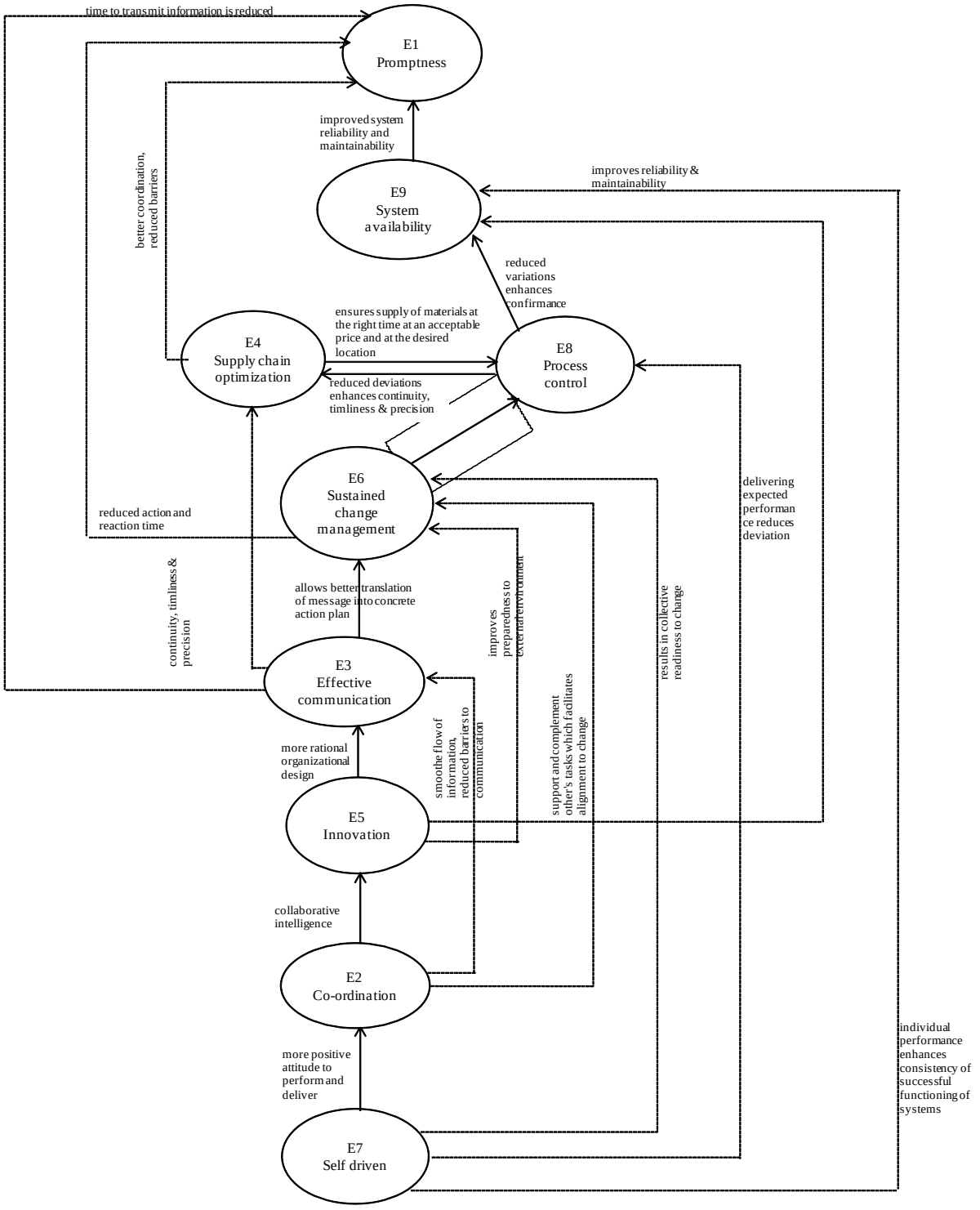

Figure 5.5: Total Interpretive Structural Model (TISM) of human body organization elements

5.4.2 Interpretations from the Model

Based on the management functionality described in previous sections, a total interpretative structural model of human body has been suggested. The developed model can be analyzed in terms of both driving and dependence influence among the enablers. Detailed analysis of the model results in following interpretations:

i. Self driven is an independent enabler with maximum driving power. Even in human body each and every unit is self driven in performing their duties. Presence of this characteristic creates more positive attitude to perform and deliver and hence drives coordination and team work.
ii. Coordination on one hand drives effective communication, and on the other hand it influences various individuals and groups to collaborate and contribute on different skills and expertise, which results in innovation.
iii. As innovation in organizations suggests better ways of doing different things, it also drives to make changes in organizational design. Such changes in turn might improve communication effectiveness.
iv. The three enablers, i.e. coordination, innovation, and effective communication; independently, and together by influencing each other, drive organizations to be more adaptive to change. Furthermore, the organizations' ability to adapt and sustain change makes it versatile in handling various changes effectively and maintaining the processes under control.
v. Effective communication in organizations facilitates continuous, timely and precise supply of input resources, thereby optimizing the supply chain.
vi. The two variables- promptness and reliability & maintainability are the outcomes or result of interplay of various enablers above them.

5.5 Conclusions

This chapter is intended to identify the enablers for organizational excellence inspired from human body; based on which a generally applicable framework that establishes relationships among these enablers has been developed. For this purpose human body systems and sub-systems were analyzed from organizational perspective. The examination of human body organization subsystems has revealed nine attributes that enable human body to become an optimally managed organization. The nine attributes

are: quick responsiveness to external stimuli, coordination, communication, control, optimal supply chain management, adaptability, reliability, innovativeness and self regulation. Subsequently, these enablers were subjected to confirmation by reviewing their relevance in current management scenario as well as by taking expert and stakeholders' opinion. Total Interpretive Structural Modeling (TISM) technique has been used to bring the interrelationship among the proposed enablers of organizational excellence derived from human body. A *human body inspired model of organizational excellence* has resulted from TISM methodology. The model developed demonstrates the key parameters and their interplay in achieving organizational excellence. Since, these parameters were based on subjective assessment, therefore need an extensive validation by conducting a survey. The validation and application of the developed model is done in next chapter.