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A General System Theory

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Abstract

The paper is presenting a general system theory on generic modelling of organisations. The theory has been developed for modelling ecological organisations, production organisation and market organisation in information technology systems. The theory presented is based on fundamental axioms, theorems and definitions and describes the system theory by dual views. The theory focuses on the relation between system ontology and system epistemology and the importance of dynamic binding in system dynamics.

Keywords

System theory; System philosophy; System definitions; System theorems; Dynamic binding

1. Introduction

System theory is a philosophical approach of modulating organisations. When Bertalanffy wrote his first paper on System theory, it was a revolt against the specialisation in science and the tendency of viewing the nature as a machine. At that time system theory represented a paradigm shift as a holistic view of science.

For some years we have been working on problems related to complex systems. First hardware multiprocessor computer system, later complex software system, IT in integrated enterprise and total quality management. In this work we had a growing feeling of the same structural problems in organisations as in computer systems.

In 1995 we started modelling the dynamics between the market and the biomass of cod in the Barents Sea. Working on this model, we found it necessary to make a new approach for modelling ecological systems, production systems and a market. Than we came up with this general system theory as a generic theory of modelling complex organisations. The need for modulating systems in a computer made it necessary to develop a notation language and clear axioms, theorems and definitions.

General system theory states that systems are something more than a sum of interacting parts, system dynamics is something more than loops and delayed responses in objects. System theory is based on an organic view of reality.

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2. System theory

2.1. Basic axioms

Axiom 1 The substance axiom

In any organisation there exist a core closed by a purpose. This core is a

$$\text{Substance} = s \quad \in w$$

where w is a closed finite purpose.

Axiom 2 The type axiom

There exits a special substance s that has the type x where

1. x has a closed purpose
2. x is not connected to other substances of the same type

Axiom 3 The state axiom

A substance s has a state

$$x = x_0$$

that is characterised by a substance value, volume, amount or a quality.

Axiom 4 The dualism axiom

Substances, objects, partners, system and models of thoughts use two, and only two, contrary principles.

A consequence of the dualism axiom is there exists a contrary flux substance a where

$$a = \neg x$$

This contrary type has the properties

1. Has a non-closed purpose
2. Is connected to two or more substances by the type x

The dualism axiom may be used on a substance, type, partner or a system.

2.2. The system doctrine

Definition 1 System

A system is a set of social, biological, ecological, technological or material partners co-operating on a common purpose.

Definition 2 System theory

System theory is a philosophical doctrine of describing systems as abstract organisations independent of substance, type, time and space.

Using the basic axioms, the doctrine of system theory may be formulated by more details.

A system has an ontology view and an epistemology view. These views may be formulated as

System =
System Ontology + System Epistemology

where *System Ontology* is the theory of the existence of system organisations and *system epistemology* is the theory of knowledge in system organisations.

System ontology and system epistemology represents dual views of system organisations. The ontology perspective represents a deterministic external view of systems as a materialistic organisation. The epistemology view represents a non-deterministic view of systems as an abstract organisation.

Definition 3 System ontology

System ontology is the theory of the existence.

This theory has the two dual views

System Ontology =
System Architecture + System Dynamics

where *System Architecture* has a structure view and *System Dynamics* has a process view the existence. When analysing these views, system architecture has information on systems dynamics and system dynamics has information on system architecture.

Definition 4 System Epistemology

System epistemology is the theory of knowledge in systems.

This theory has two dual views.

System Epistemology =
System Ethic + System Learning

Where *System Ethic* is the aim for which the system is striving. *System Learning* is the strategy, which the system chooses to reach the aim.

Comment 1 On system theory

By this system doctrine, system is something more than a sum of interacting parts. Systems are a dynamic process where the dynamics is a synthesis of the system architecture, systems ethic and a free will of learning.

3. System ontology

3.1. System architecture

Definition 5 System Architecture

A system architecture is the structure of a set partners that has a common purpose.

System architecture has the two dual views

System Architecture =
System Binding + System Partners

Theorem 1 The existence theorem

A set of substances by the type x exists in a purpose or volume w_1 if w_1 is large enough. This may be expressed as

$$X = \{x_1, x_2, \ldots, x_n\} \in w_1$$

From the dualism theorem there is a dual aspect of the substance-vector X. This aspect is binding A between the substances of X. We may then formulate a binding theorem.

Theorem 2 The binding theorem

A set of substances of type x has a binding set A between the elements x inside a purpose w_1.

This may be expressed as

$$A = \{a_1, a_2, \ldots, a_n\} \in w_1$$

where a is a relation substance between two closed substances of the type x.

Definition 6 System Binding

System binding is a substance interaction by the type A between substances of type X.

System binding has the dual views

System Binding =
System Coupling + System Cohesion

where *system coupling* indicates the strength of a connection between two partners and *system cohesion* indicates the structure of a set relations between a set of substances of type X.

Definition 7 System Coupling

System coupling is the mutual influence between a set of one partner.

System coupling has the dual views

System Coupling =
Connection coupling + Object coupling

where *Connection Coupling* may be
1. Narrow or broad
2. Direct or indirect
3. Local or distant
4. Flexible or rigid
5. Dynamic or stable

and *Object Coupling* may be
1. Direct
2. Global
3. To interface

The object may interpret the coupling as data, parameter or control.

Definition 8 System Cohesion

System cohesion is the total interaction between a set of partners.

System Cohesion has the dual views

System Cohesion =
System Binding Purpose + System Purpose type

where a *System Binding Purpose* is increased by
1. Random cohesion
2. Logical cohesion
3. Temporary cohesion
4. Procedural cohesion
5. Communication cohesion
6. Functional cohesion
7. Composed cohesion

Examples of a *System Purpose* type may be an organisation, biological objects, knowledge, responsibility, economy, ownership, instrumentation and more.

The importance of binding between objects reflects the value of partners.

Theorem 3 The value theorem

The value of a partner is dependent on the binding to its context.

Comment 2 On values

This means that the value of an object is not related to the object itself, but the binding between the object and external partners.

A cluster of substances may be grouped into partners.

Definition 9 Partner

A partner is a set of substances connected to a purpose w_1.

This may be expressed as

$$p(A, X) = \{A, X\} \quad \in w_1$$

where w_1 is the purpose.

Definition 10 Partner type

A partner type is a set of substances by type X and A that has a common purpose w_1.

This may be expressed as

$$p = \{A, X\} \quad \in w_1$$

A partner type may be classified as a substance on a higher abstraction level.

Definition 11 Partner set

A partner set is a set of partners in an expanded purpose.

This may be expressed as

$$P = \{p_1, p_2, \ldots, p_n\} \quad \in w_2 > w_1$$

Where w_2 is the expanded purpose.

Definition 12 System architecture

A *system architecture* is a set of partners co-operating on a common purpose.

This may be expressed as

$$S = \{A, \{p_1, p_2, \ldots, p_n\}\} \quad \in w_2 > w_1$$

or

$$S = P(A, P_1) \in w_2 > w_1$$

which is a set of partners as a system.

Theorem 4 Recursion theorem

Systems have a set of partners at a lower abstraction level.

This may be expressed as

$$S = P_i(A_{i-1}, P_{i-1}) \in w_2 > w_1$$

where i is the abstraction level $i = \{0,1, 2,,\}$

Comment 3 On system levels

The recursion theorem indicates that systems, partners and substances are a recursive chain of sub-systems. The difference between them is a matter of purpose, scale and application. A system is the upper selected abstraction level and the substance is the lowest.

Comment 4 On recursion and architecture

A consequence of the recursion theorem is that system architecture has a partner view and a level view.

Than we have the dual views of system partners

System Partners =
System Purpose + System Level

where *System Level* is an external classifying of a group partners by an abstraction. *System Purpose* is an internal view of classifying an internal set of partners related to other external partners in a common system.

Theorem 5 The meta-system theorem

All systems will have a meta-system, if the purpose is expanded large enough.

This may be expressed as

$$S = \underset{i \to \infty}{P_i} (A_{i-1}, P_{i-1}) \in w \to \infty$$

where w is a purpose.

Comment 5 On meta-system

By this theorem there are always a meta-system outside any meta-system when the purpose i expanded and by this theorem the limit of space is infinitive.

Theorem 6 The sub-system theorem

All systems have a sub-system if the purpose is small enough.

This may be expressed as

$$S = \underset{i \to 0}{P_i} (A_{i-1}, P_{i-1}) = s_0 \in w_i \to 0_+$$

where w_i is the purpose.

Comment 6 On the atom theory

The sub-system theorem indicates that system theory is no atom theory. Sub-systems will always exists when purposes are split into smaller parts. This means that substances and closed systems are something related to the ability of observation.

Theorem 7 The sub-system samplings theorem

Sub-systems are observed by two ore more substances.

Comment 7 On the samplings theorem

This is the dual concept of Shannon's sampling theorem, which is related to sampling of data or substances of type A. The sub-system sampling theorem is related to substances by the type x .

3.2. *System analysis*

Definition 13 System analysis

System analysis is an external observation of fundamental aspects of a system.

Theorem 8 The controllably theorem

A system s_1 is controllable if, and only if, an external binding B, from a system s_2, is able to change all states in the system set X.

Or if the system state

$$X = \{x_1, x_2, \ldots, x_n\} \in w_1$$

Is influenced by the external binding B, all states X will be changed by

$$dX = \{dx_1, dx_2, \ldots, dx_n\} \in w_1$$

The states in a partner will then be changed to

$$p(A, X+dX) = \{A, X2\} \in w_1$$

where A is the internal binding.

Theorem 9 System observable theorem

A system s_1 is observable if, and only if, an external binding D, from a system s_2, is able to detect changes in all states in the system s_1.

Or if we have a partner

$$p(A, X) = \{A, X\} \in w_1$$

and we observe a set of states

$$Y = \{y_1, y_2, \ldots, y_n\} = \{D, X\} \in w_1$$

the system is observable if, and only if, Y has information on all states X.

Theorem 10 The reflection theorem

An observed system reflects the system if, and only if, it is controllable and observable.

Comment 8 On the reflection theorem

The reflection theorem is a core principle in functionalism and classic science theory. The ability of observable and controllable, combined by the time variant properties of systems, indicates that the reflections from partners and system are a time variant dynamic process. The outcome of this theorem is, there are no absolute constant laws in this general system theory.

Theorem 11 The interpretation theorem

All observation of systems needs an interpretation.

If A_2 is the reflection from a substance X_1 than we have an interpretation

$$\hat{X}_1 = \{X_2, A_2\}$$

where X_2 is a substance set or an algorithm that is an interpretation of the reflection A_2.

Comment 9 On interpretation theorem

The consequence of this theorem is that all observation of system ontology at interpreted models.

From the reflection theorem and the interpretation theorem follows the subjectivity theorem.

Theorem 12 The subjectivity theorem

Any observation of a system, partner or substance is a subjective interpretation of censored data.

Comment 10 On system theory and system analysis

The subjectivity theorem shows there is an important difference between system ontology and system analysis. System ontology is an external view of the existing of systems. System analysis is to discover system ontology and to make a subjective interpretation in a model.

Definition 14 The uncertainty theorem

Uncertainty is observations of states from an unknown source.

If we have a set of partners

$$P(A, X) = \{A, X\} \in w_1$$

in a purpose w_1 and observes a set of states

$$Y = \{y_1, y_2, \ldots, y_n\} \in w_1$$

the system has an uncertainty if, and only if, $Y > X$

Comment 11 On uncertainty

Uncertainty is an observation from an unknown source. This means what we call uncertainty or by changes, tell us nothing about the determinism of a system. Uncertainty is an indication of the existence of system partners that is not observable.

Theorem 13 The view theorem

System view is observing some aspects of a system.

If we have a set of partners

$$P = \{A, X\} \in w_1$$

and observes a set of substances

$$Y = \{y_1, y_2, \ldots, y_n\} \in w_1$$

where we observes a view of P if

$$Y = P(A*c_1, X*c_2)$$

where c_1 and c_2 are vectors.

Comment 12 On views

Views decide which partners in a system are observable and the relation between partners. In this way views change the observed structure of a system.

Definition 15 System balance

System balance is an open system analysis of the dual aspects of a substance, type, partner or a system. From the dualism axiom a substance holism h is described by

$$h(a, x) = \{(a, x), \neg(a, x)\}$$

From this balance we may formulate the balance theorem.

Theorem 14 The balance theorem

Dual aspects of substances, types, objects, partners or system describe a complete system analysis of a system.

Definition 16 System model

A system model is described by the balanced set

$$H(A, P) = \{P_i(A_{i-1}, P_{i-1}), \neg P_i(A_{i-1}, P_{i-1})\}$$

or

$$H(S) = \{S, \neg S\}$$

Definition 17 System object

A *system object* is a closed balance of dual substances, types, object partners or systems.

Definition 18 Substance object

If we have an object

$$h = [a, x]$$

than the object is a new closed substance on a higher abstraction level.

Comment 13 On binding

If we are looking at system theory from the view S, system architecture is a set of partners connected by binding. In this system each partner has recursively a set of connected partners. From this point of view system theory is a binding theory. Using the balance theorem, a complete analysis needs analyses from the dual view. In this case binding is analysed recursively, and system looks like an object theory or a functional view of the reality.

Aristotle developed a holistic view of nature. In his discussion On the Soul, the soul has much of the same function as binding in this system theory. We may than argue that the teleology of Aristotle was a binding theory. Later Descartes introduced the doctrine on functionalism as a revolt against the doctrine on teleology from Aristotle. In this system theory functionalism is the object-view of a system. By the balance theorem these two doctrines are dual concepts.

3.3. System dynamics

Definition 19 System dynamics

System dynamics is the theory of how system states and structures are changing by the time.

According to the recursion theorem and the meta-system theorem a system is always related to other systems. If the system are controllable, the other systems will change its state.

Theorem 15 The dynamic reflection theorem

Changes in one system state will change all other controllable states in a system.

From this theorem we may formulate the system dynamics theorem.

Theorem 16 The system dynamic theorem

Substances by type a and x have always a dynamic state.

The substance a, has a non-stationary property by The inverse theorem. This means that

$$a = f(t)$$

By The reflection theorem we have

$$x = f(a)$$

Then we have

$$x(t) = f(a, t)$$

and

$$a(t) = f(x, t)$$

This means that substances of type x may be stationary as a type, but dynamic by state.

Comment 14 On dynamics

A consequence of the dynamic theorem is that there are no absolutely constant states in systems. All substances are changing by the time. When one partner is changing, it will influence all the others.

Theorem 17 The time variant theorem

All systems are time variant.

This means that there are no linear time invariant systems in a general system theory. Using such systems in computer simulations, it is always an approximation in a time-defined interval.

Definition 20 Partner dynamics

A set of dynamic states and dynamic binding represent partner dynamics.

The dynamic states is represented by the dynamic state set

$$X(t) = \{x(t)_1, x(t)_2, \ldots, x(t)_n\} \in w_1$$

and the dynamic binding set

$$A(t) = \{a(t)_1, a(t)_2, \ldots, a(t)_n\} \in w_1$$

that makes the partners

$$p(t) = \{A(t), X(t)\} \in w_1$$

where w_1 is a common purpose among partners.

All partners are changing by the time. If they are controllable, each partner will influence the state of the all other partners. We may now formulate a more general definition of system dynamics.

Definition 21 General system dynamics

General system dynamics is a dynamic binding of dynamic partners.
Or

$$S(t) = \{A(t), P(t)\} \in w$$

where w is a common purpose on partners.

Theorem 18 The dynamic partner set theorem

Structural dynamics leads to partners lifecycles

Since the binding A(t) has dynamic states between a set of partners P(t), the number of partners will change by time if two ore more partners are open systems.

$S(t) = \{A(t), \{p(t)_1, p(t)_2, \ldots, p(t)_n, n = f(t)\}\} \in w_2 > w_1$

or on a more compact formulation

$S(t) = \{p(A(t), P_n(t), n = f(t)\} \in w_2 > w_1$

which is a set of partners in a whole system.

Comment 15 On system dynamics

System dynamics is the theory of how systems are changing by time. The partner dynamic theorem indicates that system dynamics has a state view and a structure view. This may be formulated as

System Dynamics =
State Dynamics + Structural Dynamics

By this dual perspective on system dynamic

1. Systems have an autonomous dynamics
2. Systems have a dynamic binding between partners
3. Systems are time invariant and non-linear by nature
4. Systems may aggregate to meta-systems
5. Systems may disintegrate to new partners
6. Systems have a life cycle

3.4. *State dynamics*

Definition 22 State dynamics

State dynamics is the theory of how a state x(t) of substances, objects, partners or systems are changing by time.

State dynamics has the dual views

State dynamics =
Internal binding + Internal states

The State Dynamics of a partner may then be formulated as

$P(t)=\{A(t), X(t)\} \in w$

or

$S(t)=\{A(t), P(t)\} \in w$

This indicates that systems generally are time variant.

Definition 23 Time invariant systems

A time invariant system is represented by stationary binding between a set of partners. This may be represented by

$S(t) = \{A, P(t)\} \in w$ in the time (t1, t2)

Where A represents a constant and stationary binding. This is a linear system.

Comment 16 Linear systems

Linear systems are well known and there are developed a consistent theory of the properties of this kind of systems. Her is some basic concept.

Definition 24 Autonomous linear time invariant systems

An autonomous linear time invariant system is a closed system having stationary and constant internal binding. This may be expressed by

$P(t) = \{A, X(t)\} \in w$

or

$S(t) = \{A, P(t)\} \in w$

A linear autonomous time invariant system may be expressed by the difference equation

$$\dot{x}(t) = A \cdot x(t)$$

where x(t) is a state space vector and A is (n x m)-matrices that represents the bindings between the system states.

A solution of this equation is

$$x(t) = e^{A(t-t_0)} x(t_0)$$

This solution indicates that an autonomous linear time invariant systems is deterministic by nature when the start state $x(t_0)$ is known.

Definition 25 Open time invariant system

An *open time invariant system* has a reflection from external partners. This may be expressed by

$P(t) = \{A, \{A_1, X_1(t)\}, \{A_2, X_2(t)\}\} \in w$

or

$S(t) = \{A, \{A_1, P_1(t)\}, \{A_2, P_2(t)\}\} \in w$

where X_1 is an open system that reflects the state of X_2 by the binding A.

This may also be expressed by the difference equation

$$\dot{x}(t) = A \cdot x(t) + B \cdot u(t)$$

where x(t) is an open state space vector connected by the internal binding A. And u(t) is the state of an external partner, connected to x(t) by the external binding B, and represented by a (n x m) - matrix. This equation has the solution

$$\mathrm{x(t)} = \mathrm{e}^{\mathrm{A(t\text{-}t_0)}}\mathrm{x(t_0)} + \int_{\mathrm{t_0}}^{\mathrm{t}} \mathrm{e}^{\mathrm{A}(\mathrm{t}\text{-}\tau)}\mathrm{B}\cdot u(\tau)\,\mathrm{d}\tau$$

This solution indicates that the dynamic effect of the external system is related to a convolution integral. The consequence of this is that every state x(t) in a system, is influenced by the whole history of how the external partner u(t) has changed from time = 0 to time = t. But the influence is increasing the closer the time comes up to time = t.

In spite of the influence from the external partner, this is a deterministic system.

Theorem 19 State reversible ability

A system dynamic state is reversible.

Comment 17 On state reversible ability

This means that if a state is changed, it may change back to the same value. States may than be cyclic.

Definition 26 Coupled systems

A coupled system is a system where two ore more partners are mutually dependent in a common purpose.

$S(t) = \{A, \{A_1, P_1(t)\}, \{A_2, P_2(t)\}\} \in w$

or

$P(t) = \{A, \{A_1, X_1(t)\}, \{A_2, X_2(t)\}\} \in w$

where X_1 and X_2 are open systems that is mutually related by the binding A.

This may be expressed by the two difference equations.

$$\dot{x}_1(t) = A_{11} \cdot x_1(t) + A_{12} \cdot x_2(t)$$
$$\dot{x}_2(t) = A_{21} \cdot x_1(t) + A_{22} \cdot x_2(t)$$

as may be put together to an autonomous system.

$$\dot{X}(t) = A \cdot X(t)$$

where X(t) is an open state vector and A is a (n x m) binding matrix. This coupled system has the solution.

$$\mathrm{X(t)} = \mathrm{e}^{\mathrm{A(t\text{-}t_0)}}\mathrm{X(t_0)}$$

This shows that two coupled systems may be expanded to one autonomous deterministic system on a common purpose.

Comment 18 Coupled systems

This shows that an open mutual coupling between two partners represents an expansion of the system to a meta-system. This is the same as an expansion of the purpose.

Comment 19 On state dynamics

State dynamics is based on static bindings between partners. This is a flow view of system dynamics. In this view the perception of the reality is based on the first law of thermodynamics.

Definition 27 Time variant systems

A *time variant system* is a system where the bindings between system partners are changing by the time. This may be expressed by

$S(t) = \{A(t), P(t)\} \in w$

or

$P(t) = \{A(t), X(t)\} \in w$

where A(t) is the dynamic binding between partners.

This means that all systems are time variant by nature.

Theorem 20 The Dynamic level theorem

System levels have different dynamics.

From the recursion theorem this may be expressed by

$S(t) = P_i(A_{i-1}(t), P_{i-1}(t)) \in w$

where

$P_i(t) =/= P_{i-1}(t)$

Comment 20 On dynamic levels

By this theorem, systems and sub systems have different dynamics and purpose.

3.5. *Structural dynamics*

Definition 28 Structural dynamics

Structural dynamics is the theory of how the relation between partners is changing by the time.

Structural dynamics may be formulated by the dual views

Structural Dynamics =
Life Cycle Dynamics + Dynamic Binding

where

Life Cycle Dynamics is an external view of how objects behave as a partner in a system during a lifetime. *Dynamic Binding* is an internal view of how an object changes its relations to partners in a system.

By The Partner set theorem we have

$$S(t) = \{A(t), \{p(t)_1, p(t)_2, \ldots, p(t)_n, n = f(t)\}\} \in w_2 > w_1$$

as may be expressed by

$$S(t) = \{p(A(t), P_n(t)), n = f(t)\} \in w_2 > w_1$$

Comment 21 Structural dynamics

Structural dynamics is different from the functionalism concept and makes a number of new concepts.

Definition 29 Global integration

Global integration is an aggregation of partners into meta-systems. Such integration will change the purpose of the system.

On a system

$$S(t) = \{A(t), P_n(t), n = f(t)\} \in w$$

the number of partners in a global system will be reduced.

Definition 30 Fragmentation

Fragmentation means that a system is split into sub-systems that has weak or no mutual binding.

On a system

$$S(t) = \{A(t), P_n(t), n = f(t)\} \in w$$

the number of n is increased when a system is fragmented.

Definition 31 Catastrophe

Catastrophe is a chain reaction of fragmentation.

Theorem 21 The irreversible theorem

Time variant systems are irreversible.

Comment 22 On irreversible systems

This means that if we change relations between partners, the partner states will never go back to the same states. The reason is that if a partner return to the same bindings, the states has changed in the mean time. Than we will never have the same cyclic process. This effect is well shown in a chaos attractor.

Definition 32 Instances

Instances means that as system is creating a copy of it self by genes.

On a system

$$S(t) = \{A(t), P_n(t), n = f(t)\} \in w$$

the number n is increased by instances.

Definition 33 Life cycle

A *life cycle* is the structural dynamics of a partner, from the time it is integrated into a system, and to the time it has left the system.

A life cycle has the two dual perspectives.

System Life Cycles =
Binding Life Cycles + State Life Cycles

which has different properties.

Definition 34 State life cycle

A *state life cycle* is a change of system states $x(t)$ from an initial value x_0 to a new set X of from states and back to the starting state x_0 in that time it contributes to a common purpose.

Definition 35 Binding life cycles

Binding life cycles is the life cycle of a binding to a set of substances or partners.

This is the view from the partner it self. The partner gets into a system goes out of it.

Theorem 22 The System Entropy theorem

The entropy of a system is increasing by the number of partners in a purpose w.

Or

$$E = f(P_n(t)) \in w$$

where E is the entropy and n is the number of partners.

Theorem 23 The work theorem

External work on a system changes the number of binding in a system and increases the system entropy.

Comment 23 On the work theorem

This means that any work in organisations will increase the entropy in nature.

Comment 24 Sustainable environment

By this entropy theorem sustainable environment is true when the entropy reduction in nature is greater than entropy increasing by work. This is different view of dynamics in nature that traditionally is based on a flow perspective.

Theorem 24 Aggregating theorem

Systems are reducing entropy by aggregating sub-systems to meta-systems

Comment 25 On thermodynamics

1. The thermodynamics of the first law is an energy balance law. This law balances the energy in system states.
2. Thermodynamics of the second law is a structural law that balances irreversible bindings between states.

These two laws then are dual concepts of this holistic system theory.

4. System epistemology

Definition 36 System epistemology

System epistemology is the theory of knowledge in systems.

By this general system theory, systems are something more than a sum of related parts. Systems have knowledge of how to survive.

Comment 26 On knowledge

There are different views of what knowledge is. This doctrine on system theory is based on a cybernetic view of knowledge.

Definition 37 On knowledge

Knowledge is how the system adapts to a purpose by changing bindings between systems, partners, objects, types or substances.

Comment 27 On knowledge

By this definition knowledge is
1. Something subjective and not something absolute
2. Related to a system level
3. Not related to an abstraction but a process
4. A structure between partners and system levels

System epistemology is the dual view of system ontology that represents a non-deterministic view on the reality. This view may be split into the two new dual concepts

System Epistemology =
System Ethic + System Learning

Where *System Ethic* is an aim perspective view of knowledge in systems and *System Learning* is an adaptive view of knowledge in systems.

4.1. System ethic

Definition 38 System ethic

System ethic is the main idea a system is striving for.

This idea is a process-oriented approach. System ethic has the two dual views.

System Ethic =
System Purpose + System Potential

Definition 39 System purpose

System purpose is an external view of realising the system main idea.

Definition 40 System potential

System Potential represents an internal view of realising the systems idea.

System purpose has the dual properties

System Purpose =
Internal Dynamics + External Specialisation

where *Internal Dynamics* is an internal view of a life cycle. *External Specialisation* is an external view of a specialisation related to the purpose of a meta-system.

Comment 28 On Internal Dynamics

Internal Dynamics is how the system itself meets its own life cycle. This is something different from system purpose and system dynamics, which is based on an external observation.

System potential has the dual concepts

System Potential =
System Resources + System Genes

Where *System Resources* is the energy the system is using to sustain and optimise its life cycle and *System Gene* is a potential instance of the system.

Comment 29 On system potential

From this view a main ethic is to use potential in system resources and system genes.

System Genes have the dual views

System Genes =
Ontology Genes + Knowledge Genes

Which represents different theories of understanding instances and life cycles of systems.

Definition 41 Ontology Genes

Ontology Genes are the theory that systems have the ability of making new system knowledge by instances of it self.

Comment 30 On ontology genes

The theory of ontology genes represents an organic view of nature that may be traced back to Aristotle.

Definition 42 Knowledge genes

Knowledge genes are the theory that systems have an ability of creating new system ontology by knowledge genes.

Comment 31 On knowledge genes

The theory of knowledge genes is a view of nature that may by traced back to Plato. This general system theory combines these theories as dual concepts.

The theory of system genes leads to the immortality theorem.

Theorem 25 The immortality theorem

Systems strive for immortality by making instances of it self.

Comment 32 On immortality

Instances are strategy systems are using to meet a long-term idea. This is necessary to maintain meta-systems.

4.2. System learning

Definition 43 System learning

System learning is adoption of system dynamics to fulfil system ethics.

Comment 33 on learning

This view of learning is based on the theory that systems are non-deterministic by nature and that systems has limited time dependent free will.

This is a cybernetic view of learning. By this view a system has an inside and outside disturbance. Learning is how to control inside and outside system dynamic in a way that the system ethics is maintained.

By this view, system learning has the dual elements

System Learning =
System Identification + System Adoption

Definition 44 System identification

System Identification is to identify the dynamic properties of external partners. By the reflection theorem, this may be expressed by the dual views

System Identification =
System Observation + System Prediction

Definition 45 System observation

System observation is a representation of a substance, partner or a system by a model.

Definition 46 System prediction

System prediction is the ability of prediction future state dynamics on external partners.

Comment 34 System prediction

System prediction is based on the theory that systems are deterministic by nature.

Definition 47 System Adoption

System Adoption is changing internal states and external bindings.

Comment 35 On adoption

Changing the strength of bindings will influence internal states of all partners in a system. This is the same as serial control in cybernetics. A dual control concept is to change relations between partners. This is the same as parallel control in cybernetics. Both concepts will change the state and dynamics for all partners in a system.

We may than introduce the dual views on system adoption

System Adoption =
Dynamic Binding Strength + Dynamic Binding

Where *Dynamic Binding Strength* is related to control of data flow between partners and *Dynamic Binding* is selecting new partners.

Comment 36 On system adoption

There is an important difference between dynamic binding strength and dynamic binding. Dynamic binding needs a free will to choose new partners. This means that in a general system theory, systems are something more than a deterministic machine. Systems have a free will to choose new partners to reach a purpose.

Theorem 26 The free will theorem

Systems have a free will to choose new partners.

Comment 37 On free will

Free will has always been a basic problem in philosophy, science and modulation. In this system theory free will is necessary to change relations between external partners.

Free will leads to time variant systems. From an external point of view this may look like chaos or as a temporary unstable system.

5. Biography

Harald Yndestad received has a degree in cybernetics from University of Trondheim. He has worked 10 years research on complex IT systems at NDRE in Norway and since 1982 been ass. Prof. at Aalesund college. The last years he has been engaged in research on system dynamics of north arctic cod, knowledge based IT-systems and general system theory.

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