# Complying with the Rules of Asimov

Renate Luise Ackermann

D - 53173 Bonn, Dürenstr. 29
Renate_Ackermann@t-online.de

**Abstract:** Social systems are calling attention to adequate sets of rules as e.g. to comply with the rules of Asimov as a codex [BF05]. In the context of Multiple Sensor Data Fusion (MSDF) a variety of interacting (logical) sensor agents might autonomously self-organize their part of complex tasks' organizational solution processes due to co-operations, communications and co-ordinations. Even computational participants might change (or be changed in) their role according to the open distributed system's organization's needs, the environmental changes, or decisions on their own, e.g. temporarily, as a guide being guided, as a chasing entity being chased, or as a member of a coordination being independent. The goal of this paper is to exemplary discuss the rules (chosen of some divisions of modern robotics) and a derivative set to accomplish the model AIKM [Ac08] in the concern of security and safety taking the knowledge distance as a key-factor focusing decisions, divergent trends, a.o.

## 1 Introduction

Taking into account the variety of sensors from a simple tactile sensor up to the high complex sensors of a certain degree of intelligence, a sensor management of dimensions as (logical) sensors [Mi07], sets of sensors, sensor networks, entities, attributes, subjects, space and time, comes up near to the focus of a holistic Knowledge Management (KM). Intelligent sensors may fit for some new categories of conceptions, methods, and system models.

Intelligence in this context is taken as the entities' capability to cognitively focus on the requirements, the tasks, and the conditions for adaptation (Stern, 1912). It is to be understood as the capability of perception, cognition, judgement, to analyse the wide comprehensions of possibilities, but also to realize the ideas' associations and (anticipated) cognitions about them. (ref. [GW03] p.2)

Artificial Intelligence (AI) is defined as the research on computational methods enabling perceptions, and actions according to the own deep reasonings, in contrast to the classical informatics. AI has interdisciplinary characteristics. Just in the concern of the cognitive scientific part there is already a need to cooperate with research fields as philosophy, psychology, linguistic, and neurosciences. In contrast to the psychology, AI is distinguished by discussing the computational aspects. (ref. ib. p.1)

KM is focusing on the human (in a sense also interpretable as a system of sensor systems scaling up to the highest complexity), technics, organisation, guidance, environmental interferences, and both, the strong and the weak points of holistic knowledge scenarios, and the ability to organizationally evolve.

The basic model AIKM-0, which is inspired by the SECI-Theory [NT95], a core theory of KM [Jä08], was already discussed in the context of MSDF as a process fusioning the data, information, and knowledge of complementary awarenesses, evolved due to a knowledge generating spiral, which complies with the main life cycle of model AIKM: The combinations of different perspectives, methods, structures, and reasoning facilities might offer potentials of more attention and quality in complex solution processes.

This paper discusses a new step of an iterative upgrading of AIKM continuing a dialogue of a remarkable knowledge distance *kd* between the KM- and MSDF-Communities. It discusses the model in the context of an artificial social system ($S^2S$) including virtual participants on one hand, and involved experts and system specialists in an iterative process of modelling on the other ($H^2S$ and $S^2H$): In an inner loop the open distributed (logical) sensor systems iteratively develop, requiring an overall loop involving multi specialists. Each discipline and facility has its own focus on a problem solution process. Thus real-world tasks should be supported by interdisciplinary and transdisciplinary cooperations to develop the desired holistic solutions ($H^2H$).

Cooperations of intelligent agents and autonomous sensors of different complexity do need to a certain degree the capability to initiate adequate reactions on unforeseen events and states of their own, and in general of all entities, individuals, groups, organizations, interorganizations, (aspect) worlds, or (of regions) of the environments at all.

Thus there is a need of a common language, a set of rules, and reference systems.

AIKM-0 already called for rules of organization, service routines, announcements, a language for participation, and balancing mechanisms [Ac08].

AIKM-1 now adds the rules of Asimov chosen of some robotic divisions as a codex [BF05] especially caring for security and safety and a balancing of additional dimensions.

Chapter 2 will introduce the proposed set of rules twice, the original one for obligation concerning $H^2S$ and $S^2H$, and the additional variation for option in the concern of $S^2S$ (both participants are system entities), firstly, defining the two consecutive sets of rules, secondly, discussing some issues in this concern, and finally, a state transition diagram marking out AIKM's improved degree of competence.

The paper ends with a summarizing discussion and conclusion in chapter 3 and 4.

## 2 The Model's Rules of Asimov

With refer to the rules, which had been mentioned first by Isaac Asimov in his novels, some divisions of modern robotics define the codex of need today [BF05].

### 2.1 The Consecutive Set of AIKM's Rules

The rules of organization, service routines, announcements, and the common language for participation called by AIKM-0 are now accomplished as follows:

Q5: An entity (individual, group, organization, interorganization, (aspect) world a.o.) should do **no** (physical, data, information, knowledge a.o.) **harm to a human**, and should **not tolerate** by its own behavior, that any **harm** will be done **to a human.**

Q6: An entity have to **obey to commands of a human**, if it complies with rule Q5.

Q7: An entity has to **care for itself**, but also to comply with rule Q5 and rule Q6.

The leitmotiv might be considered not only in the concern of human (for obligation), but also depending on competence, process segment, responsibility etc. in the concern of any entity of all ontological levels of the focused holistic social system (for option).

Thus AIKM offers additionally as an optional extension of the set Q5..Q7:

Q8: An entity should also do **no harm to an entity**, and should **not tolerate** by its own behavior, that any **harm** will be done **to an entity.**

Q9: An entity have to **obey to commands of an entity**, if it complies with rule Q8 and rule Q10.

Q10: An entity has to **care for itself**, but also to comply with rule Q8 and rule Q9.

Announcements for participation will always define the current competence marking the activated $Q_i$ in a "genome" and additionally their degrees of quality. This will be a key for interpretation to estimate the believed quality, when evaluating an event or result referring to the touched participants on their identity during the life cycle process. The $Q_i$-profile also allows to describe a variety of (logical) sensors of different degree of intelligence and the kind and expected weight of their type dependent participation.

### 2.2 Issues in this Concern

The rules for obligation should be generally a codex from a holistic point of view, and also in unknown (virtual) systems to care for any form of potential HCI at any place [SSG08], and in representations in cultural memories and communication systems.

The rules for option might be oblige in certain cultures for a variety of reasons, e.g. simply according to any (aspect as) costs, situations, or process segments, but also according to the task or degree of competence. It depends on the weighted estimation of

some factors of interest.

Both sets of rules have to estimate according to issues as situative thresholds, adequate tolerances, current reference systems, and valid norms, to stabilize the set of autonomous systems, and to care for the potential HCI considering also representations and interfaces among the entities theirselves, each of which being responsible for its own functionalities having an eye on the organizational interests.

A harm might be defined as to lengthen any *kd*-facet of interest, to worse a quality of a result, a flow, or a capability of an entity of the focused (real) world as a current key-factor. This is exemplary to be converted to a general balancing of information culture in the focused (artificial) social system, i.e. in the concern of

Q5: e.g. ensure representations, and balance
data, information, and knowledge divide [Sc05]

Q6: e.g. care for research and intended use
of data, information, and knowledge

Q7: e.g. ensure own fit, and mind the competence
of others and the organizational and aspectal priorities

Q8: e.g. cooperate, communicate, coordinate, and
check alive signals

Q9: e.g. constructively (min: not destructively) assist, and
adapt the (selection) pressures

Q10: e.g. check regularly, repair, and recover in time,
self-controlling, and self-modifying,

To enhance the value is to shorten any facet of a *kd* upgrading due to the adequat combinations of competences, experiences, and responsibilities, due to more chances to improve by cultural rules $Q_i$, sufficient resources, certainty, and differentiations, as situatively deepening the general reasoning (ref. Figure 1, next page). Also to better is to avoid barriers of flows, deviations, and dominated or asymmetric concurrencies, if they might fail. New conceptions should be proved in advance according to adequateness to the (complexity of the) types of the entities to ensure the intended positive spiral effect. Of interest are co-operations and co-ordinations, the facets of competence per entity adequate to the complexity, keeping a general focus on interdisciplinarity and trans-disciplinarity, fair competitions, communicating direct, precise, detailed, and intimate in case of need, controlling the ripeness, and keeping the focus on security, safety, and sustainability, etc.

### 2.3 The State Transition Diagram of AIKM

A (virtual) blackboard (ref. [St03] p.24, [Bu03] p.1001) might function as one of the communication systems, multiplicated to one per subarea, or one per cluster or entity,

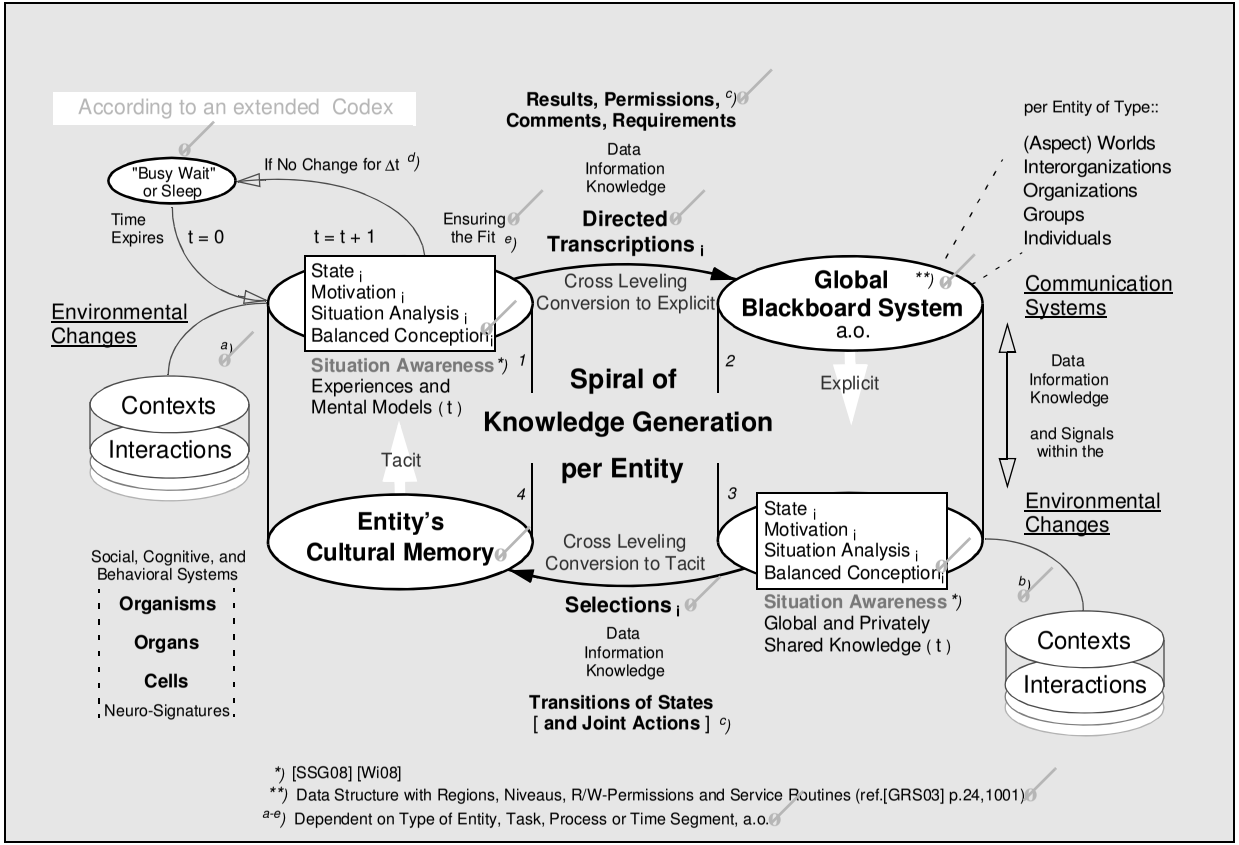


**Figure 1**: State Transition Diagram of the Organizational Knowledge Creation of Model AIKM (inspired by [NT95])

dependent on the scenario. Interactions else run as environmental changes, taken as interfering "contexts" of the main (Figure 1).

The entities develop the system inspired by the SECI-Model [NT95][Ac08] in four phases per cycle, accomplished with the extended codex, exemplary in phase

(1) Build conceptions based on experiences, mental models and cultural memories,
e.g. with respect to all partners,
controlling pollutions, addressees, and the own functions,

(2) Communicate and ease the knowledge transfer, and feedback in case of need,
e.g. keep the current cultural level or improve it,
ask questions, and comment,

(3) Combine environmental changes and shared knowledge acc. to the set of goals,
e.g. care for any research, the evolutions of others,
and comment,

(4) Internalize selections of interest to extend adequate their own cultural memory,
e.g. care for cultural development and
drop redundancies, and the out-of-dates,

All entities in AIKM repeat this set of four phases always deciding from their own point of view according to their own and the higher leveled goals (organizational knowledge).

### 2.4 On the Influence on the Decisions

Referring to the new sets of rules for obligation and for option, the process will be upgrated by these balancing mechanisms of social dimensions supporting interferences according to the competence in need, i.e. the adequateness of the set of competences to the given problem solution process determines the knowledge distance *kd* as a key-factor. *kd* will be the central multifacetted measure to ease the decisions, able to distinguish, identify, and decide according to the relevance of the facets in the very moment.

### 2.5 On the Influence on the Productions Processes

The power of production processes is dependent on the amount or lack of resources, which might be influenced to a certain degree by social rules. The new sets of rules controls the resource flows on a higher level of competence. The flow of information will be quickly reflected, multiplicated, and continuously changed according to the quality and responsibility of networking nodes. This is one of the very points the new rules might enable to better focus on the flows.

## 3 Discussion

While, firstly, sensors were developed in order to improve the human perceptions, meanwhile, components of computational intelligence are developed to improve the performance of complex sensor systems as robots, and phased array radars [SSG08] [Wi01] [He08] [Ko08], enabling co-operations, communications, and co-ordinations, viewing the sensor systems as (networks of) autonomous organizational evolving systems at any point also including HCI, i.e. the sensor systems are to be seen as clusters of heterogenous social systems with a variety of human factors [SSG08] [Wi08] to be taken into the considerations.

Knowledge from the point of view of KM is to be interpreted as a result of a process of learning, whereas both, learning and knowledge can interfere and improve each other to any steps of reflexivity during the system's life cycle process. Thus knowledge generating and knowledge transferring presume a process of learning, which itself includes communications in social systems: The languages, the background knowledge, the identity, and the capability of learning are fundamental for the process of learning and the knowledge process itself. (ref. [Wi02] p.19-20)

This knowledge concept presumes communications and an understanding, but also the ability to classify and organize the perceptions. It eases now to distinguish between the concept of knowledge and the concept of intelligence, and supports a better understanding of the organic or mechanical intelligence without communication: these perceptions are transferred via the genome and will be evolved by biological mechanism only, but not due to an understanding and high-level communication. Human or social systems (including actors as e.g. robots or autonomous sensor agents) might solve problems due to their experiences and according to cultural rules. Biological or mechanical intelligence is to be viewed as less complex and more static than the focused concept of knowledge, which additionally presumes the capability to make experience and to solve problems on the base of a dialogue between autonomous systems and their environments. Systems are in so far intelligent as they solve their problems routinely in a certain cultural social practice. (ref. [Wi02] p.22-24)

The discussions of a knowledge distance *kd* between complementary areas of disciplines and new research fields as in [We07], requiring capacities not only to solve a problem but also to define it, ask for a particular management of knowledge work [ES07]. These discussions are usually in need of metaphors, and can be supported by adequat abstractions and game theoretic approaches [Sh08] to gain the required indications and general acceptance of the new mechanism designs.

The goal of game theoretic approaches is to simulate particular patterns of behaviour, to find common issues of interest for the experts of multi sites, the transparence and understanding, reducing the specifics on one hand, asking for adaptations on the others. The abstractions then will function as basic structures to bridge the disciplinary gap and to ease the dialogues of need to build on organizational evolving. An analysing report [Re92] pointed out, that missing communications in cases of a remarkable *kd* had been one of the very reasons of the failing of expert systems in the eighties.

The reductions to principle solutions help to keep the focus on the very set of patterns of behaviour (strategies) propagated by the AIKM-series, transparently outlining exemplary key-points or degrees of competence development according to the different types of sensor agents or organizations to support general discussions. (For the same reason tools are currently not mentioned in the AIKM-series, without loss of generality.)

The focus of the algorithmic distributed mechanism designs is on a given set of desired outcomes and the goal to design a game that will achieve them, inversely to the game theory, which is focusing the given rules of game and the goal to predict an outcome [Va08].

One of the challenges is, to become able to up-level according to new contexts and new sets of rules, to improve even the culture of artificial social systems, enabling for the new balances, due to selected conversions as the rules discussed here. At the same time, it is to care for a process of self-control on all ontological levels, not to down-level and to worse the established cultural standards shifting thresholds, and ignoring rules.

Viewing the importance of the knowledge distance *kd* in the context of the transdisciplinary and interdisciplinary understanding is one of the key-factors improving the organization of (artificial) problem solution processes of high complexity. KM is generally focusing the development of the (human) competence in a variety of facets to enable those kinds of solution processes. Adequate conversions to artificial organizations are calling for improvements of the production process always again, which itself calls for weak and strong knowledge refinements of the producing entities of different ontological levels of organizational competence.

## 4 Conclusion

The advantage of both sets of rules, the chosen and the proposed set, is,

- to encourage a competence development to a cognitively balancing of higher dimension as a key to improve the degree of system intelligence,
- to realize an exemplary step in particular in the concern of security and safety, and
- to communicate partly established contributions of the AI-Community to support the focused dialogue now facing the KM-Community bridging a real disciplinary gap,
- while offering new aspects of design of high complex distributed (sensor) systems due to the interdisciplinary discussions of new perspectives, differentiations, etc.

One of the challenges is, to focus on the knowledge distance
as a multidimensional measure

- of e.g. the adequateness of the competence of competing casts to a given task to really improve the organizationally competence of the (artificial) solution processes, enabling the process to optimize the problem solution process,
- i.e. to shorten the knowledge distance between the developed process and the focused realistic process,
  controlling the deviation from the truth, distinguishing experiences, etc.,

and as a contribution to the transdisciplinary and interdisciplinary understanding.

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