



25th IVR World Congress
LAW SCIENCE AND TECHNOLOGY
Frankfurt am Main
15–20 August 2011

Paper Series

No. 026 / 2012

Series A

Methodology, Logics, Hermeneutics, Linguistics, Law and Finance

Vytautas Čyras / Friedrich Lachmayer

Multisensory Legal Machines and Legal Act Production

URN: urn:nbn:de:hebis:30:3-248848

This paper series has been produced using texts submitted by authors until April 2012.
No responsibility is assumed for the content of abstracts.

Conference Organizers:

Professor Dr. Dr. h.c. Ulfrid Neumann,
Goethe University, Frankfurt/Main
Professor Dr. Klaus Günther, Goethe
University, Frankfurt/Main; Speaker of
the Cluster of Excellence “The Formation
of Normative Orders”
Professor Dr. Lorenz Schulz M.A., Goethe
University, Frankfurt/Main

Edited by:

Goethe University Frankfurt am Main
Department of Law
Grüneburgplatz 1
60629 Frankfurt am Main
Tel.: [+49] (0)69 - 798 34341
Fax: [+49] (0)69 - 798 34523

Vytautas Čyras, Vilnius / Lithuania*

Friedrich Lachmayer, Wien / Austria**

Multisensory Legal Machines and Legal Act Production

Abstract: This paper expands on the concept of legal machine which was presented first at IRIS 2011 in Salzburg. The research subjects are (1) the creation of institutional facts by machines, and (2) multimodal communication of legal content to humans. Simple examples are traffic lights and vending machines. Complicated examples are computer-based information systems in organisations, form proceedings workflows, and machines which replace officials in organisations. The actions performed by machines have legal importance and draw legal consequences. Machines similarly as humans can be imposed status-functions of legal actors. The analogy of machines with humans is in the focus of this paper. Legal content can be communicated by machines and can be perceived by all of our senses. The content can be expressed in multimodal languages: textual, visual, acoustic, gestures, aircraft manoeuvres, etc. The concept of encapsulation of human into machine is proposed. Herein human-intended actions are communicated through the machine's output channel. Encapsulations can be compared with deities and mythical creatures that can send gods' messages to people through the human mouth. This paper also aims to identify law production patterns by machines.

Keywords: Institutional fact, Legal act, Legal status, Legal informatics, Legal visualization, Multisensory law, Production and communication pattern, Human and machine, Encapsulation, Information system

I. Machines and Humans are Similar in Legal Context

This paper addresses people and machines as actors within legal transactions. The role of machines in the shift from raw facts to institutional facts is the subject matter. Raw facts are from the Is world whereas institutional facts – from the Ought [Kelsen 1967, § 3 ff.].

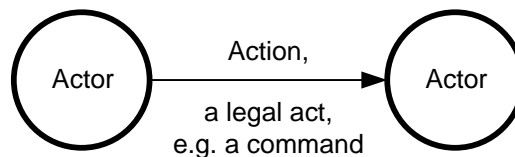


Fig. 1: An actor (human or machine) executes an action which has legal importance

* Associate professor, Vilnius University, <http://www.mif.vu.lt/~cyras/>.

** Professor, Leopold Franzens University of Innsbruck, <http://www.legalvisualization.com>.

We continue investigating the legal machine concept [Čyras & Lachmayer 2011]. A first glance is as follows. An actor (a human being or a machine) executes an action (a legal transaction, *Rechtsgeschäft*). The action is addressed to another actor or actors; see Fig. 1. In this paper the term “actor” is preferred to “agent” which is reserved for meanings used by informatics community in the domain of multi-agent systems (MAS).

The Is world can be visualised with the metaphor of the stage. Here we view machines in the foreground and people in the background; see Fig. 2. Real-life workflows comprise both human beings and machines. Decisions are qualified as legal acts. Thus the workflows deal with conditions and effects. Legal theory appears as a metasystem. Objective law and legal theory impose a structure on machine behaviour.

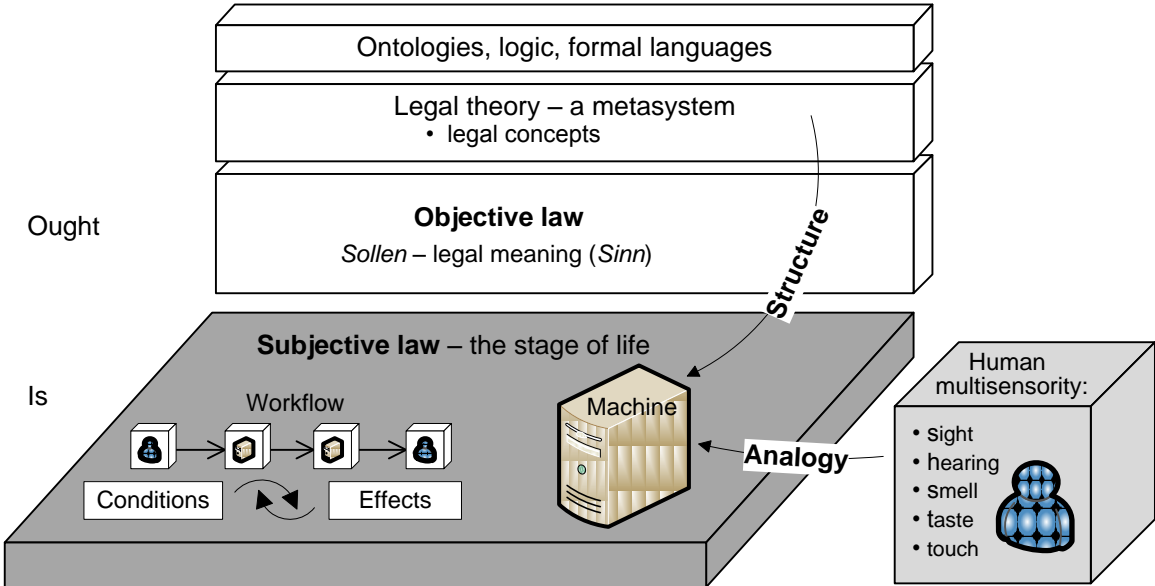


Fig. 2: Legal machines in context: machine = analogy of human on the horizontal Is stage

Machines communicate acts to humans who perceive the legal contents by multiple senses (sight, hearing, smell, taste and touch). Thus a kind of multisensory legal communication is observed. For the term “multisensory” we are indebted to Colette R. Brunschwig and her research on multisensory law (2003; 2011); see Section V.2.

II. Legal Machines in Context

Factual acts are from the Is world (i.e. the reality that is) and do not have legal importance whereas legal acts have it and also an interpretation with respect to the Ought world.

A starting point of our departure is that machines are tools. Technology is substrate and thus it is not part of law. However, institutional facts can also be triggered by machines. The

context of legal machines is introduced by the following cases: (1) vending machines; (2) traffic lights; (3) form proceedings such as FinanzOnline, <https://finanzonline.bmf.gv.at/>, in Austria; and (4) machines which are auxiliary to officials in organisations.

Thus the point of departure is that an actor makes an *action* with an *effect* and this is under a condition, e.g. “Alice puts a coin in her piggybank”. Thus we start with the *condition-actor-action-effect* model. To illustrate the notation, following is an instance, *factualAct₁*:

factualAct₁ = ⟨ *condition* = *undefined*,
actor = ‘Alice’,
action = ‘drops a coin in her piggybank’,
effect = ‘making savings’ ⟩

Besides a human being and a machine, the actor can also be a deity, a text, etc. Legal importance is observed in conduct implying intent (*konkludentes Verhalten*) such as Chris putting coins in a ticket machine. A fraud is committed when dropping fake coins in a vending machine whereas a child may put old coins in her piggybank. McCormick & Weinberger [1992, 49-92] advocate a view “Law as institutional fact”.

Factual acts can be lifted to the legal acts category by the actor’s role, for example:

factualAct₂ = *listener_John_enters_courtroom*
legalAct₂ = *judge_Ken_entering_courtroom*
factualAct₃ = *pedestrian_Mike_raising_hand*
legalAct₃ = *policeman_Steve_raising_hand*

No legal consequences are implied by *factualAct₃*, whereas *legalAct₃* implies: drivers are obliged to halt. Legal effects are important whereas the types of legal acts – speech acts or implications – are not. Persons putting coins into a vending machine engage in sales contracts. The condition can also have legal importance, e.g., road radars make photos when the vehicle’s speed exceeds certain value. Hence, each element – the legal condition, the legal actor, the legal action and the legal effect – are qualified to have legal importance.

In the contract example, the relationships *condition-actor-action-effect* have horizontal – individual – effect since they concern private law. Traffic lights have vertical – general – effect as regulated by administrative law. The traffic lights normativity can be expressed in different formalisms. A pedestrian is prohibited to go on a red light, *F(go)*, and permitted on

green, $P(go)$, though he can wait on the pavement, $P(\neg go)$, too. The automaton's states are turned from red to green or vice versa. The algorithm changes permissions and obligations and distributes legal time and space between pedestrians and drivers.

In proceedings workflows such as e-Government application FinanzOnline, decision makers are comprised of humans and machines. Data input is a legally binding act. Computers that are comprised in information systems are substantially more complicated than simple legal machines. Here recall e-Government applications. Suppose a machine is described in terms of finite state automaton (*endlicher Zustandsautomat*). The number of its states can serve as a measure of complexity when comparing two machines. For instance, a very simple traffic light consists of three states: 'red', 'yellow' and 'green'. On the contrary, information systems have substantially more states. Each keystroke can raise a different event and it brings the system to a distinct state (*Zustand*).

There are no big differences between machines and humans in the production of legal acts by organisations. Suppose an official selling train tickets. A traveler makes a contract with the organisation – not with the cashier. Therefore the cashier can be replaced with a ticket machine. The right of representation is an issue. The question is, can machine represent an organisation's body? The answer depends on the legal position of machines. This is the subject matter of regulation by the law. The legal status results from the legal order (in accordance with the Ought; cf. also Pufendorf's *impositio*). A legitimisation is necessary. Then machine can count as administrator in organisation; see the formula "X counts as Y in context C" [Searle 1995, 114]. Hence, two alternative bridging relationships with a third person, the buyer, are: (i) organisation - *administrator* - person, and (ii) organisation - *machine* - person. The first arch in (i) and (ii) results respectively in two encapsulations, *organisation-in-administrator* and *organisation-in-machine*. In both cases the representation powers are scoped by the seller's function.

Today machines *per se* still do not reach the level of legal persons. They lack legal capacity and contractual capacity. However, imagine a register in future which is operated by a machine. It will become a kind of e-Person; see e.g. [Schweighofer 2007]. This is not in a reality yet. A paradigm shift for future is to complement legal actors with machines.

Administrator-organisation relationship is similar to that of a slave which makes a contract in favour of his master. The slave is a thing. However it is important that slaves could make contracts for their masters. The contract is not for slave but *via* him. Thus two alternatives exist: via slave or directly. Machine's position in nowadays organisations can be compared with the legal position of a slave.

Machines appear in context which is important for human as it comprises various extra-legal contexts, such as cultural, political, social, technical, and economic [Brunschwig 2011, 577] and issues, e.g. legal protection, appeal, etc. The language to communicate the output from machine to human needs not to be a natural language like English or German.

III. An Analogy between Machines and Humans

Four types of relationships to send legal content are possible: two types on the output side – human and machine – and two on the input. These four interaction types are viewed differently in the context. The internal representations of information are different: texts for humans and programs for machines. Therefore, on the metalevel, different requirements arise for human-human and computer-computer interaction. The incoming texts can be read by people, but programs cannot be read by the users.

1. Actor, Norm and Role

We associate an actor with a norm, *n* (a general and abstract norm from the reality that ought to be). Here we do not discuss whether this is one norm or a system of norms. The content of the norm is the subject matter of material law and is out of scope of a jurisprudential survey.

A certain *role* can be assigned to an actor executing an action. A role is a set of rights, obligations, and expected behaviour patterns associated with a particular social status. A role identifies a whole type (*genus*) of behaviour – not an instance. Role's name is a label such as 'traffic light', 'vending machine', etc.

An actor complies with *n*. In the case of machine, software code enforces *n*. Suppose a norm model *condition-subject-modus-action*, where modus is 'obligatory', 'permitted', 'forbidden', etc. The factual act model *condition-actor-action-effect* conforms to it. Every concrete actual actor has to match the norm's condition and subject.

The sender who commits an action can be represented as an agent – “anything that can be viewed as *perceiving* its environment through *sensors* and acting upon that environment through *actuators*” [Russell & Norvig 2003, 32].

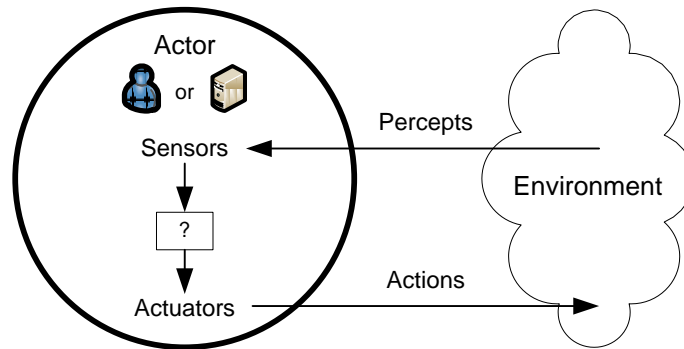


Fig. 3: Actor viewed as an intelligent agent. Agents interact with environments through sensors and actuators; adapted from [Russell & Norvig 2003, 33]

“A human agent has eyes, ears, and other organs for sensors and hands, legs, mouth, and other body parts for actuators. A robotic agent might have cameras and infrared range finders for sensors and various motors for actuators. A software agent receives keystrokes, files contents and network packets as sensory inputs and acts on the environment by displaying on the screen, writing files, and sending network packets” [ibid. p. 32]. A vending machine has a mechanism to cash money and a mechanism to give the item. A traffic-light reacts to time and the light bulbs stand for actuators.

To implement a machine agent, software engineers need a specification. Writing it is the subject matter of informatics, namely, requirements engineering.

2. *Situational Flexibility*

Human-human interaction is more flexible than human-computer. People can adjust their behaviour to a concrete situation. As an example suppose a train approaching a station and a person under stress going to buy a ticket. It makes a difference to buy from a cashier or a ticket machine.

Multisensority can ease layman’s interaction. Multiple channels, such as voice, face expression, eye contact, etc., can be used concurrently to explain situation details to an administrator. Machines are less flexible in interpreting this multichannel information. But success stories of human-computer interaction by voice exist, e.g., a driver or a military pilot commanding the machine in a quickly changing environment.

Situational flexibility features can be foreseen in machine specifications. An illustration is a rapid but expensive service instead of a slow but cheap. Communication in emergency situations, such as a need of ambulance, police or fire fighters, can be regulated by law.

3. Multiple Human Senses – Multiple Formats

Multisensory properties mean multiple input channels. Next question is how to manage outputs which are produced by output channels.

For example, a legal act which forbids entering can be issued by different actors including machines and technical devices. In the case of a policeman raising hand and whistling, a human recipient perceives the message by sight and hearing. A traffic sign is sensed by sight only. A barrier can also be sensed by touch. The understanding of verbal signs such as ‘Betreten verboten’ can be limited on people understanding German.

The format of a recipient’s input channel can be modelled with a parameter in the message representation *command(format, content)*, for example:

```
command(format=gesture, content=“Policeman raising hand” )
command(format=acoustic, content= “Policeman whistling” )
command(format=visual, content= “Traffic light turns red” )
command(format=visual, content= “”)
command(format=visual, content= “”)
command(format={visual, touch}, content= “A road barrier on the street” )
```

These messages mean the obligation to halt (with semantic nuances), *O halt* or *O no action*. Hence, a need appears for a notation of normative multisensory messages.

This is similar to the multiple formats of text documents. A document can be produced in multiple output formats such as TXT, DOC, HTML, etc. Digital signature and other properties can also be foreseen. Similarly, a legal statement can be outputted differently.

Suppose a linear structure *subject-predicate-object* to model sentences in a self-conscious language. What are sentence formats in the unconscious and could non-linear formats be more effective? The question can be formulated: Can the cognitive cube be diced in other formats for visual, acoustic, motor functions, textual, logical, etc. representations of legal contents (Fig. 4)? Distinct formats result in different document types. For example, the rules of computer actions are represented in programs, not in texts.

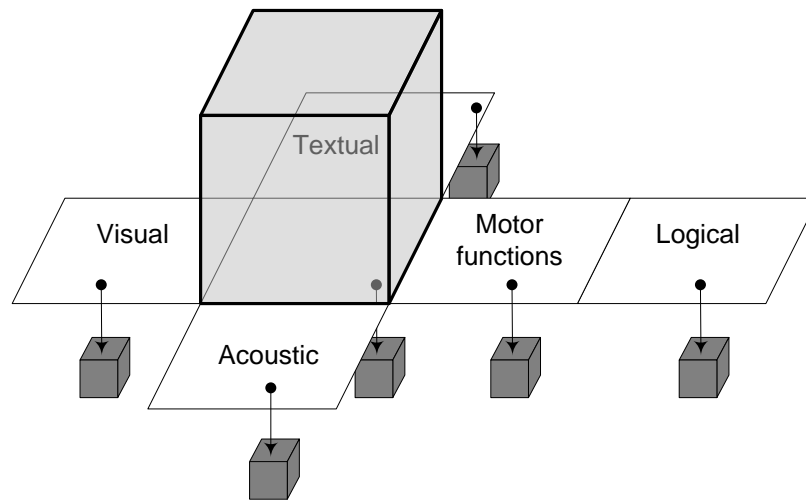


Fig. 4: The metaphor of unfolding multisensory cognitive cube to multiple formats

4. Multisensory Law is at the Periphery of Textual Law

Suppose designing a multisensory legal machine such as traffic lights for disabled people. It has to be equipped with sound devices and touch panels. Therefore, first, the (verbal) road rules concerning disabled have to be transformed into legal content (multisensory commandments), which would be perceived by disabled. Next transformation leads to technical statements which implement the legal content to be sensed by hearing and touch. The resulting acoustic implementation can be achieved with the following transformations:

Norm(subject-predicate-object) → command(acoustic, “beep”) → technical instructions

Consider multiple transformations from the law through legal informatics to informatics. The multibrige metaphor is shown in Fig. 5. In these transformations, multisensory law appears at the periphery whereas textual law is at the centre. Law is always textual for jurists.

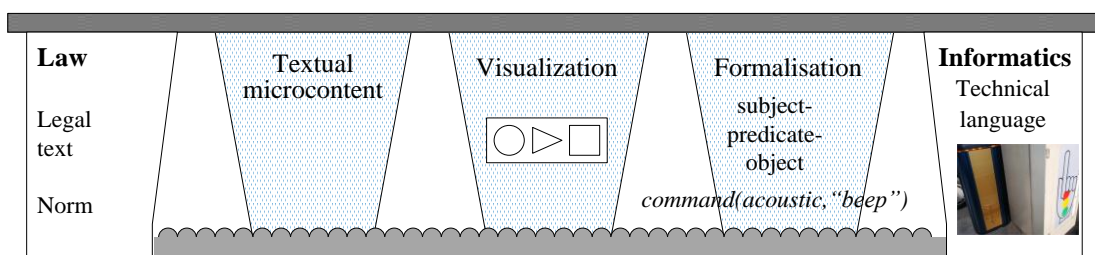


Fig. 5: The multibrige metaphor: transformations lead from norm to its machine implementation

5. Multisensory in Procedural Law

Law concerns several tiers. The lowest tier is actors’ behaviour on the Is stage where actors interact in different forms: written, oral, gestures, etc. The ‘what’ is regulated by material law whereas the ‘how’ by procedural law. Parliaments cannot regulate so flexibly comparing with technical standards which regulate multisensory communication. The reason is that legal

systems have to satisfy the minimality principle. Therefore the weak rules of multisensory behaviour are placed in technical standards. Though, e.g. the written and oral forms of proceedings are regulated by the law. Examples of uni- and multisensory legal or legally relevant phenomena are provided in [Brunschwig 2011, 592-599]: voting in a parliament and video recording during the questioning of children.

The actors on the horizontal Is stage, humans and machines, communicate through various channels. Promulgation rules on the vertical tier of law could also be extended to multimodal channels such as Braille or voice. Reasonableness of this is next question.

Hence, normative multisensority is a matter for wide regulation by technical standards that are made by expert groups. Technical issues should not be overregulated by the laws. Outdating technologies would be illegitimate. Recall the data protection law which required the currently outdated RTF format.

Some machine types can communicate in signal languages that are regulated by technical standards. The combinatorics of human gestures and machine signals is addressed further.

IV. Formalising Legal Machine as Encapsulation

Formal models of the issues which are raised above are a challenge. Actors can be classified into humans, animals, allegories, machines, etc. Humans are legal actors whereas animals are not. Allegories such as the state and juristic person can denote legal actors. Legal machines are not juristic persons, however can be assigned a status-function.

1. Human-in-Machine is Similar to Human-in-Animal Encapsulation in the Ancient World

Examples of transformations of a human being into an animal and vice versa can be found in Greco-Roman myths. Mythical creatures such as minotaur¹, centaur², sphinx, etc. embody encapsulations. The Mechanical Turk³ is an example of human-in-machine. In these ways human and animal combinations can be complimented with the encapsulations of machines: human-in-machine (e.g. The Turk) and machine-in-human.

The word “person” is derived from Latin persona – actor’s mask, character in a play, later human being. “The term “person” refers to “man as a player of roles”” [Pattaro 2007, 376]. The word refers to an abstract thing and can be implemented by machine.

¹ In Greek mythology, the Minotaur, as the Greeks imagined him, was a creature with the head of a bull on the body of a man or, “part man and part bull”; see <http://en.wikipedia.org/wiki/Minotaur>.

² Composite race of creatures, part human and part horse; see <http://en.wikipedia.org/wiki/Centaur>.

³ A fake chess-playing machine; see http://en.wikipedia.org/wiki/The_Turk.

2. Transforming Humans into Animals and Machines

Human-to-animal transformations in the ancient world are about transforming a man into an animal such as a bird or an ass⁴; recall the myth about Midas⁵ and Apollo. The combinatorics to explore concerns four kinds of entities: (1) animal, (2) human, (3) mask – person (*persona*) including allegories such as state and juristic person, and (4) machine. Each entity speaks a specific language. An example of acoustic output is a phone answering machine or GPS which give commands in voice. Formal logic is more a language of machines than people.

We define *encapsulation* of an actor *A1*, called *encapsulator*, into an actor *A2*, called *encapsulatee*, to be a new actor denoted *A1-in-A2* with the following abilities (Fig. 6 and 7):

- a) the encapsulator monitors (i.e. gives commands to) the encapsulatee in a language *L1* which is understood by both *A1* and *A2*;
- b) legal content is sent to third persons in a language *L2* of *A2*;
- c) encapsulator's goals (i.e. motives, objectives, values) are pursued;
- d) encapsulatee's channels are used to transmit legal content.

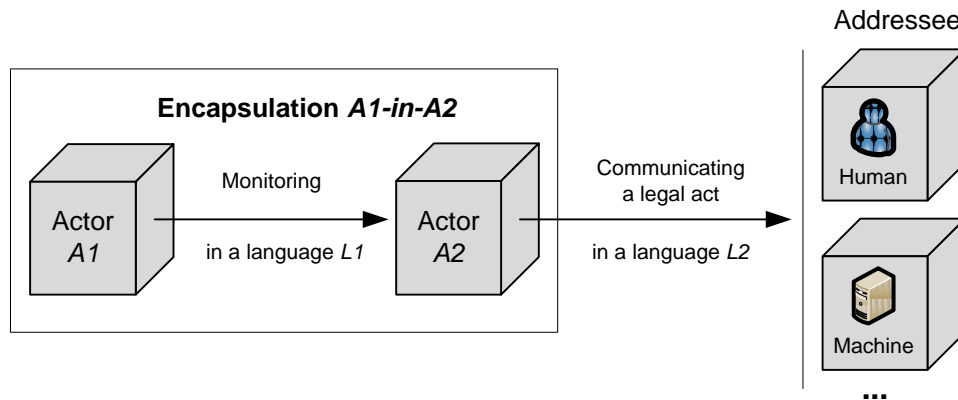


Fig. 6: Encapsulation *A1-in-A2* communicates legal act to addressee

The idea is that a man *A1* is empowered with a tool *A2*. Not all human functions of *A1* are empowered, but a specific one, that is regulated by a norm *n*. A purpose is to combine the capabilities of both *A1* and *A2*: $capabilities(A1-in-A2) = capabilities(A1) \cup capabilities(A2)$.

⁴ http://en.wikipedia.org/wiki/The_Golden_Ass.

⁵ <http://en.wikipedia.org/wiki/Midas>.

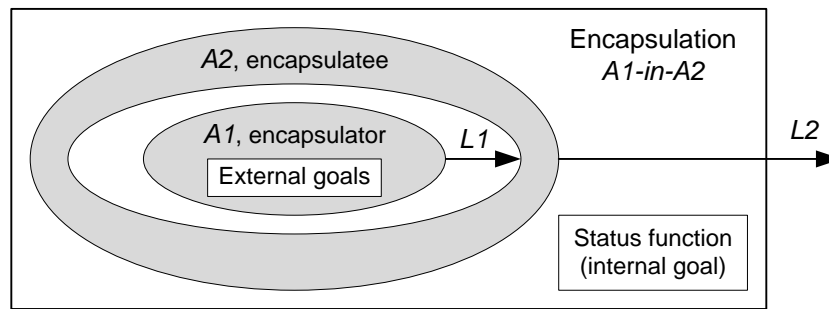


Fig. 7: Encapsulation *A1-in-A2*

3. Encapsulation and Goals

Encapsulations are viewed as goal-governed systems. The encapsulator embodies the external goals concept⁶. These external goals are intrinsic in a norm n for which the encapsulation *A1-in-A2* is designed. The legal texts which serve as input to the legal machine *A1-in-A2* can be viewed as a source of n .

The encapsulation *A1-in-A2* can be assigned a status-function. This status-function can be viewed as goal of use value (to be apt to ... [Conte & Castelfranchi 1995, 124]) on *A1-in-A2*. Conte & Castelfranchi note that the goal definitions could be shared with the cognitive sciences: “a goal is a representation of a world state within a system” [p. 123].

Intentional goals (i.e. serving as external goals, values, intentional stance) cannot be assigned to every entity. Intentional stance is not intrinsic to machines. Deities and some allegories such as states and juristic persons can be assigned goals but machines cannot. “A stone *per se* does not have and cannot have any kind of goal” [Conte & Castelfranchi 1995, 123-124]. Paraphrasing this, a machine (a tool, a gun) *per se* is neither good nor bad.

4. Examples of Encapsulation

Deities in Greco-Roman mythology have the form of human bodies. Recall gods, titans, etc. Personifications obtain both unnatural physical powers of gods and human bodily features. The human mouth sends legal content to people.

Which type to assign to this pair of human and machine: human-in-machine or machine-in-human? A starting point is that machines are tools monitored by humans. Second, machines do not have goals. The aim of coupling is to leverage human’s capabilities. In a powerful combination, humans give intelligence to machines whereas machines leverage physical and computational capabilities of human beings. People obtain capabilities to fly, etc.

⁶ We follow [Conte & Castelfranchi 1995] and their terminology; see especially Chapter 8 “Towards a unified theory of goals and finalities”, 120-141.

The encapsulation definition above implies the following consequences.

- *Human-in-machine* means that *human's goals* are pursued and *machine's channels* are used to transmit legal content. The human uses the machine as a tool, e.g. pilot-in-aircraft and driver-in-car.

- *Machine-in-human* encapsulation means that *machine's goals* are pursued and *human's channels* are used to transmit legal content.

Suppose a *policeman-in-machine* example. A policeman watches images on computer display that are transmitted from a distant camera which monitors a barrier. The policeman's command to stop the traffic is expressed in machine's gesture – the barrier is being dropped.

A meaningful example of *machine-in-human* encapsulation can be hardly provided. The reason is that machines do not have goals. Nevertheless, suppose a malfunctioning machine *A1* sending a false alarm to a human *A2* who commands alarm with bad consequences.

Human-in-machine examples below illustrate how human functions are assigned to machines and animals:

- *Pilot-in-aircraft*. Suppose two aircraft in the air. The first pilot orders the second one immediate landing. The signaling is in aircraft gestures, e.g. waving aircraft wings. The first pilot stands for *A1* and his aircraft for *A2*. The goal of *A1* is to force landing the second aircraft. Aircraft signal language stand for *L2*.

- *Policeman-in-car*. Suppose a policeman *A1* in a car *A2* commanding a violator driver to stop. Any communication channel can be used: car lights, manoeuvres, a loudspeaker or even a gun. The goal is to stop the violator. Car signals stand for *L2*.

- *The Turk*. The type is *humanOperator-in-machine*. The operator stands for *A1* and the mechanical device that moves chess pieces for *A2*. *A1* aims to win against the opponent player thus cheating him that machine thinks. Chess moves stand for *L2*.

- *Human-in-animal*. The “Golden ass” mythical story illustrates a transformation of a man into an animal. The man *A1* intends to spy with the goal to practice magic. Therefore he intends to transform into a bird *A2*. The *man-in-bird* would acquire the capabilities of both. However, while trying to perform a spell to transform into a bird, he is transformed into an ass.

5. Representing Communication via Phone and Skype as Encapsulation

Phone and Skype communication between humans $H1$ and $H2$ is described below to illustrate the *human-in-machine* notation. The communication chain between $H1$ and $H2$ is represented with two encapsulations and one transmission (Fig. 8).

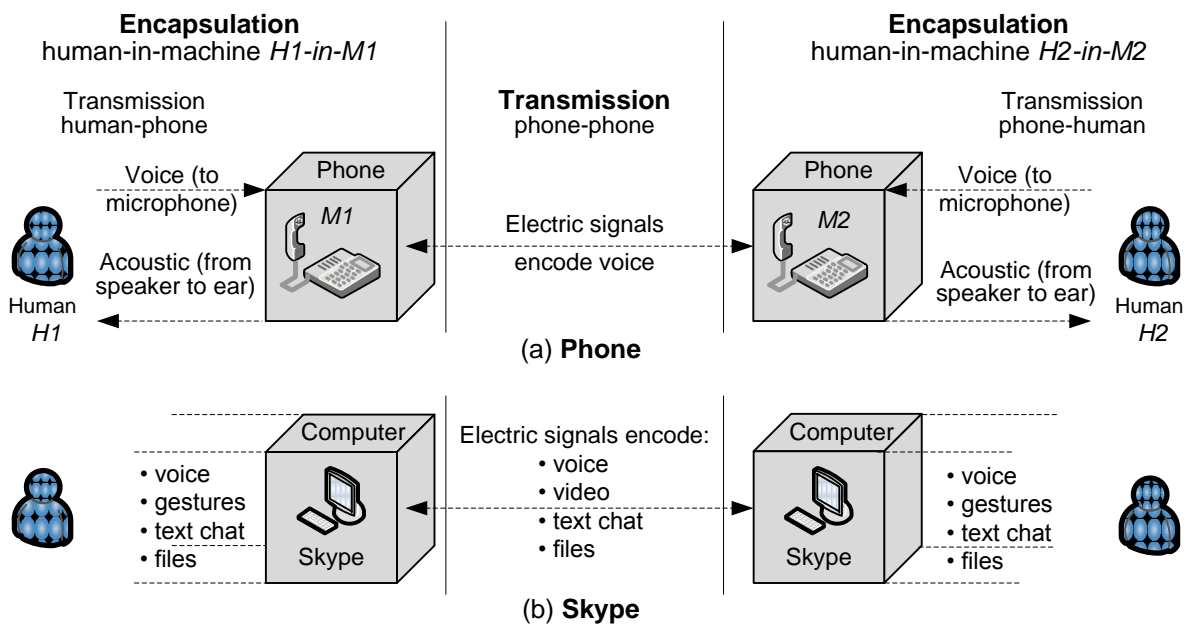


Fig. 8: Human-in-machine encapsulation in communication via (a) phone and (b) Skype

There are two channels between $H1$ and his phone $M1$: (i) voice to the $M1$'s microphone, and (ii) acoustic signal from the $M1$'s speaker to ear. The transmission between the two phones is through one channel: electric signal encodes voice. The whole chain is:

1. Encapsulation human-in-machine $H1$ -in- $M1$: A message from $H1$ to $M1$ is transmitted by voice. $M1$ encodes voice messages in electric signals.
2. Communication: The message is transmitted from $M1$ to $M2$.
3. Encapsulation human-in-machine $H2$ -in- $M2$: $M2$ transforms electric signals into the phone's speaker vibration thus transmitting to $H2$ via the acoustic channel. $H2$ is encapsulated into $M2$ with the purpose to receive electric-signals, which are decoded to acoustic signals by the speaker.

A simple phone can hardly be viewed as a legal machine but legal status can be imposed on intelligent machines. Skype communication employs video and file transfer as additional channels. Therefore people can also communicate in gestures and mimics via Skype.

Other devices and languages can be used, especially for medium distance transmission. Examples are naval flag signaling and Morse code which can be transmitted by lights. Lighthouses can be viewed as legal machines for seamen, radio beacons – for pilots, etc.

6. Encapsulations into Human: *X-in-Human*

In contrast to encapsulations of human, *human-in-X*, that are described above, following is an example of encapsulation into human, *X-in-human*, and into animal, respectively:

- *allegory-in-human*: “Leviathan” by Thomas Hobbes.⁷ The type is *stateAllegory-in-humanFormSovereign*. The state allegory, *A1*, is encapsulated into the human-form sovereign Leviathan, *A2*. The *L2* language is that of rule by an absolute sovereign – to wield the sceptre, a gesture language.
- *mask-in-animal*: Biblical Leviathan.⁸ The type is *gatekeeperMask-in-biblicalAnimal*. A gatekeeper mask, *A1*, is encapsulated into a biblical sea monster, *A2*. The allegory can be viewed as a *mask-in-animal*. The Hell gate keeping language stands for *L2*.

Actors such as animals, masks and allegories can be attributed intentions. The actors’ demands can be viewed as goals. Therefore the encapsulations animal-in-machine, mask-in-machine and allegory-in-machine are meaningful. A question is: How to attribute responsibilities to the actors? Natural persons and juristic persons are held liable. The attribution of liability to animals and natural things is an issue of a historical survey.

V. Related Work

1. On the Concept of Role

Ordinary people think in terms of roles whereas jurists – in terms of rules. The mask and persona concepts can be modelled by roles. The role’s name is treated as a label such as ‘administrator’, ‘user’, ‘guest’, etc. (in the case of computer users). Actors send legal content to norm addressees, ordinary people. The addressee is attributed a role.

In information systems engineering, a *User* is typically defined as a human or a software agent. Here we cite [Matulevičius & Dumas 2011] who compare security models and adapt Role-based Access Control (RBAC)⁹ that restricts system access to authorised users. The

⁷ See the frontispiece of the book; [http://en.wikipedia.org/wiki/Leviathan_\(book\)](http://en.wikipedia.org/wiki/Leviathan_(book)).

⁸ A sea monster referred to in the Bible, one of the seven princes of Hell and its gatekeeper; see <http://en.wikipedia.org/wiki/Leviathan>.

⁹ D. F. Ferraiolo, R. Sandhu, S. Gavrila, D. R. Kuhn, R. Chandramouli, Proposed NIST Standard for Role-based Access Control. ACM Transactions on Information and System Security (TISSEC), 4(3), 2001, 224-274.

main elements of the RBAC model are *Users*, *Roles*, *Objects*, and *Permissions* (Fig. 9). A *Role* is a job function within the context of organisation. Role refers to authority and responsibility conferred on the user assigned to this role. *Permissions* are approvals to perform one or more *Operations* on one or more protected *Objects*. An *Operation* is an executable sequence of actions that can be initiated by the system entities. An *Object* is a protected system resource (or a set of resources). *User assignment* relationship describes how users are assigned to their roles. *Permission assignment* relationship characterises the set of privileges assigned to a *Role*.

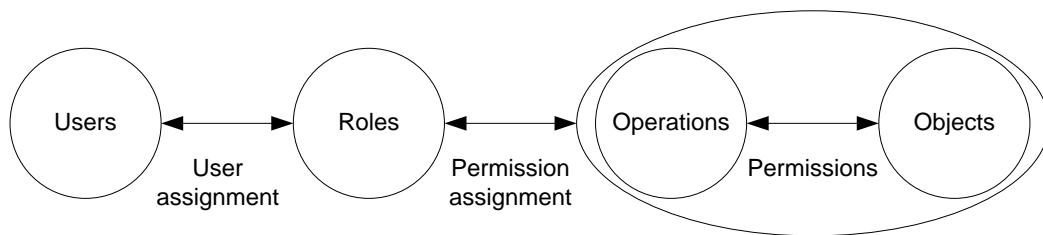


Fig. 9: RBAC model by Matulevičius & Dumas who adapted it from Ferraiolo et al. (2001)

2. Legal Machines in Multisensory Law

Colette R. Brunschwig (2003) proposed the term “multisensory law” (“multisensory jurisprudence” as a synonym) and advocates that it is about multimodal (visual, audiovisual, etc.) representation and communication of valid legal content (*geltendrechtliche Inhalt*):

The valid legal content denotes the content of valid law and also the content, which is significant for it. [Mit „geltendrechtlichen Inhalten“ meine ich Inhalte des geltenden Rechts, aber auch Inhalte, die für das geltende Recht bedeutsam sind. p. 413]

Traditionally legal actors are comprised of lawyers, judges, administration officials, parliament members, etc. [p. 411]. “Multisensory” implies that, at all times, more than one stimulus is involved in affecting a human being [2011, 581]. Discipline’s definition not trivial:

Modifying the noun “law,” the adjective “multisensory” refers to which kind of law or which law is at stake. The law in question is not, for instance, copyright law, family law, or penal law, but another legal discipline, that is, multisensory law. The term “multisensory law” not only has terminological implications, but also concerns its subject matter and cognitive interest. [2011, 591]

The subject matter of multisensory law consists of three phenomena [p. 592]; see Table 1 below. The subject matter of legal informatics is analogous; cf. [p. 630].

	The subject matter of multisensory law	The subject matter of legal informatics
A	The uni- and multisensory phenomena in the law	The ICT-based phenomena in the law
B	The law as a uni- and multisensory phenomenon in the law	The law as an ICT-based phenomenon in the law
C	The law as a uni- and multisensory phenomenon (the law in uni- and multisensory phenomena)	The law as an ICT-based phenomenon (the law in ICT-based phenomena)

Table 1: The subject matter of two disciplines; adapted from figures in [Brunschwig 2011, 592 and 630]

The words above are so interwoven that it is not easy to grasp the distinctions at once, but Brunschwig explains the meaning further in her analysis. Her study raises deep questions and also serves as a reader on several fields:

...a first systematic knowledge basis for multisensory law and particularly for its relationship to visual law. ...It has also added to what is known about legal informatics, notably about its branch artificial intelligence and law and its subarea visual legal representation. [p. 648]

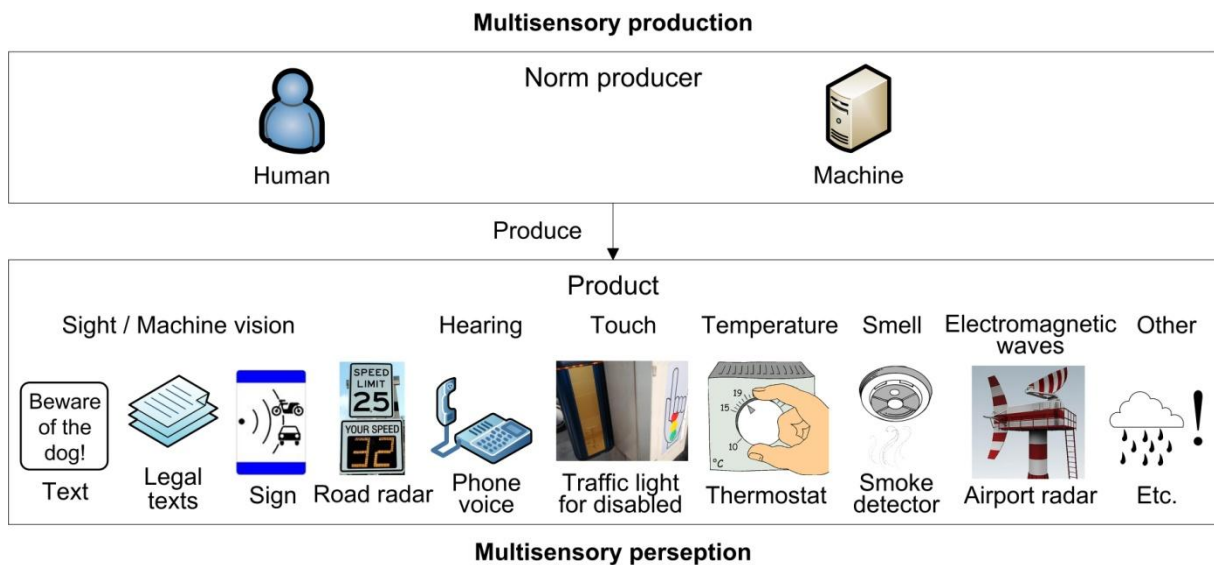


Fig. 10: A variety of modes in the production and perception of legal content

Brunschwig’s classifications enable us to relate the subject matter of the analysed disciplines to machines. For example, legal visuals can be produced by computers. Thus machines would be related to the questions raised by her, e.g. “How do multisensory law and legal informatics relate to audiovisual law, auditory law, tactile-kinesthetic law, and olfactory-gustatory law?” [p. 648]

We illustrate below some patterns of multimodal machine communication. Road and airport radars are examples of visual and radio communication where machine vision produces legal consequences. A voice example is hearing commands in your phone: “In the case of...press 1, etc.” A thermostat perceives temperature changes and turns the heating system on. Prescriptive gestures can be performed by machines, too; see *pilot-in-aircraft* encapsulation in the previous section. Multisensory production and perception are distinguished. The variety of modes is shown in Fig. 10.

VI. Conclusions

In this paper we depart from the view that machines are tools. The target view is that legal machines are legal actors that are capable of triggering institutional facts. Any computer bit can encode a complex meaning. In organisations there is an analogy between the administrator’s position and machine. Legal content can be expressed in multimodal languages (visual, audio, gestures, etc.), communicated by machines and perceived by all of our senses.

To express that a human *A1* is encapsulated into a machine *A2* we introduced the concept of encapsulation. Actions intended by *A1* are communicated to third persons via the output channel of *A2*. Encapsulations can be compared with mythical creatures, part human and part animal, which can send gods’ messages through the human mouth.

Multimodal communication is regulated by technical standards that give flexibility to the “how”. The promulgation law cannot regulate so flexibly. This paper aims at a formalisation, which is suitable for both legal scholars and (software) engineers.

References

- Colette R. Brunshwig, Tabuzone juristischer Reflexion. Zum Mangel an Bildern, die geltendrechtliche Inhalte visualisieren, in: *Zwischen Rechtstheorie und e-Government: aktuelle Fragen der Rechtsinformatik*, eds. E. Schweighofer, F. Lachmayer, Schriftenreihe Rechtsinformatik, Bd. 7, 411-420, Verlag Österreich, Wien, 2003.
- Colette R. Brunshwig, Multisensory Law and Legal Informatics – A Comparison of How these Legal Disciplines Relate to Visual Law, in: *Strukturierung der Juristischen Semantik – Structuring Legal Semantics. Festschrift für Erich Schweighofer*, eds. A. Geist, C. R. Brunshwig, F. Lachmayer, G. Schefbeck, 573-667, Editions Weblaw, Bern, 2011.

Rosaria Conte, Cristiano Castelfranchi, *Cognitive and Social Action*, UCL Press, London, 1995.

Vytautas Čyras, Friedrich Lachmayer, *Distributive Multimedia and Multisensory Legal Machines*, in: *Europäische Projektkultur als Beitrag zur Rationalisierung des Rechts, Tagungsband des 14. Internationalen Rechtsinformatik Symposions IRIS 2011*, eds. E. Schweighofer, F. Kummer, 567-574, Österreichische Computer Gesellschaft, Wien, 2011.

Hans Kelsen, *Pure Theory of Law*, 2nd ed. (transl. by Max Knight), University of California Press, Berkeley, 1967.

Neil MacCormick, Ota Weinberger, *An Institutional Theory of Law: New Approaches to Legal Positivism*, D. Reidel Publishing Company, Dordrecht, Holland, 1992.

Raimundas Matulevičius, Marlon Dumas, *Towards model transformation between SecureUML and UMLsec for role-based access control*, in: *Databases and Information Systems VI, Selected Papers from the Ninth International Baltic Conference, DB&IS 2010*, eds. J. Barzdins, M. Kirikova, *Frontiers in Artificial Intelligence and Applications*, vol. 224, 339-352, IOS Press Amsterdam, 2011.

Enrico Pattaro, *The Law and the Right: A Reappraisal of the Reality that Ought to Be, A Treatise of Legal Philosophy and General Jurisprudence*, v. 1, Springer, Dordrecht, 2007.

Stuart Russell, Peter Norvig, *Artificial Intelligence: A Modern Approach*, Prentice Hall, 2003.

Erich Schweighofer, *e-Governance in the information society*, in: ed. E. Schweighofer, *Legal Informatics and e-Governance as tools for the Knowledge Society*, LEFIS Series 2, 13-23, www.lefis.org/images/documents/outcomes/lefis_series/lefis_series_2/capitulo1.pdf (16.02.2012), 2007.

John R. Searle, *The Construction of Social Reality*, Penguin Books, London, 1996.

Address (corresponding author): Vytautas Čyras, Faculty of Mathematics and Informatics, Vilnius University, Naugarduko 24, LT-03225 Vilnius / Lithuania.