# Chapter 14
# A Modeling Tool for Exploring Business Ecosystems in a (Pre-)conceptual Phase


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**Abstract** When modeling real-world activities involving social, economic, and technical aspects, conceptual modeling is a necessary prerequisite to set the stage and define the system boundaries. This can become a very difficult task, however, especially when all the relevant actors, shareholders, and stakeholders together with their intrinsic and extrinsic motivations are not known. One of the methodological challenges in this is to provide a unified framework for collecting as many relevant perspectives and pieces of information as possible for creating a fully comprehensive representation that is both insightful and readily understood. Another challenge is to transform these findings into standardized and re-usable information which can serve as input for other modeling tools downstream in the tool chain. In this chapter, we will present both a methodology based on value networks and a modeling tool (*EcoViz*), which is intended to address these issues and can also be used directly before the typical conceptual modeling starts in the course of a "pre-conceptual phase." We will also show how the identified interactions can be used for an insightful qualitative analysis and exploration of socio-technical ecosystems. To demonstrate how and where *EcoViz* can be applied, we will show four real-world cases from different domains.

**Keywords** Modeling · Conceptual modeling · Pre-conceptual modeling · Socio-technical system · Business ecosystem · Ecosystem analysis and design · Modeling tool

## 14.1 Introduction

Conceptual modeling along with its tools and frameworks has grown into a mature and widely accepted method in the context of mapping real-world activities to

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processes supported by automated services in the area of business informatics. With OMiLAB [1], a powerful platform is available that allows tool chains across different levels of detail and domains.

While the actors involved together with their goals and motivations are in many cases a given input for conceptual modeling, there are often situations where not all relevant activities and their logical connection and interdependence are clear at the beginning of the conceptual modeling phase. While a classic situation analysis can handle many of these information deficits, things become significantly more complicated when dealing with socio-technical systems in which not all relevant actors, shareholders, and stakeholders together with their intrinsic and extrinsic motivations are known. There are several approaches for tackling this problem, mostly from a social science perspective as in [2] or as outlined in [3]. Research in the area of stakeholder theory focuses particularly on the identification of stakeholders and the analysis of various properties of identified stakeholders such as power and interest [4, 5], whereas research in the area of value networks puts emphasis on the value exchange relations and their influences on business model and strategic aspects [6–8]. These socio-technical systems form networks of individuals and organizations with individual needs connected with value exchange relations between each other. We understand the viable forms of these networks as business ecosystems and thereby follow the definition of a business ecosystem of Moore [9] (p.26) as "[a]n economic community supported by a foundation of interacting organizations and individuals - the organisms of the business world. This economic community produces goods and services of value to customers, who are themselves members of the ecosystem. The member organisms also include suppliers, lead producers, competitors, and other stakeholders. Over time, they co-evolve their capabilities and roles, and tend to align themselves with the directions set by one or more central companies."

One of the methodological challenges here is to provide a unified framework for collecting as many relevant perspectives and pieces of information as possible and creating a fully comprehensive representation that is both insightful and readily understood. Another challenge is to create an information base from all of this, which provides standardized interfaces using modeling standards such as the Unified Modeling Language (UML) to other modeling tools for allowing the use of the relevant information by others.

With *EcoViz*, we provide a modeling tool which is intended to be used directly before the typical conceptual modeling starts—in the "pre-conceptual phase"—for business modeling and requirements engineering. Its main purpose is to provide the relevant components and their relationships as inputs for other modeling frameworks down the tool chain. The secondary use, which has proved to be sometimes equally as important as the main purpose, is to provide a structured and holistic basis for performing a qualitative analysis and exploration of business ecosystems [10, 11]. Here the benefit lies mostly in understanding the dynamics of interactions and value exchanges between players in a business ecosystem—both for tangible and intangible assets according to concepts used in value networks [12].

While the proposed technique has been successfully applied in various analog and digital formats across many domains and in different levels of detail, the biggest impact can be expected when implemented as a digital tool, embedded in a platform and connected to other apps.

We will outline the conceptual foundations of *EcoViz* and its key functionalities in the following paragraphs. To demonstrate the areas in which it can be applied, we have chosen use cases from different domains representing also different granularities of a system perspective:

- Ecosystem analysis for new business areas (technical equipment manufacturer),
- Dynamics of stakeholder interaction (service design in health care),
- Data privacy and legal aspects (surveillance operations via drones),
- Process interaction and use case analysis (public safety operations).

These cases will be modeled using *EcoViz* for illustrating the method and all tool functionalities.

## 14.2 Method Description

In practical modeling, the biggest challenge often lies right at the beginning, before the actual modeling starts. This is, when the modelers are facing a real-world situation which they are supposed to understand and for which they must create a mental abstraction good enough for producing a valid model thereof, what is done in the so-called conceptual phase. Here the basic primitive building blocks of such models are chosen including the relevant entities representing actors, stakeholders, their interaction, and other relevant mechanisms and processes affecting the real-world system. The reason why this is so challenging lies in the fact that real-world scenarios include a sheer endless multitude of potentially important levels of detail and an altogether endless magnitude of entities and interactions when it comes to selecting either the right scope or the system boundaries. Usually this step is done using pre-existing knowledge or experience, which is a good pragmatic approach and works well in moderately complicated settings. In more complex settings, where, for example, social and technical systems interact in previously not observed patterns or where aspects of these systems have unexpectedly become so important that they have a predominating influence on the system behavior, this approach is no longer sufficient. In such situations, pre-conceptual modeling is needed as a pre-processor to conceptual modeling. The basic assumption here (in agreement with Socrates) is "to know that we don't know" or to quote the former US secretary of defense, Donald Rumsfeld: "There are known knowns … But there are also unknown unknowns." A frequently successful way to tackle this problem or at least to increase the chances for getting a better understanding of the real-world situation that is to be modeled is to start a system exploration by studying historic artifacts (records, user stories, etc.) and seeking live interaction with the people who appear to be relevant in the respective setting. This is usually done in process exploration

workshops where all relevant people are summoned and share all their knowledge and perspectives. But where to start? Which people should be invited?

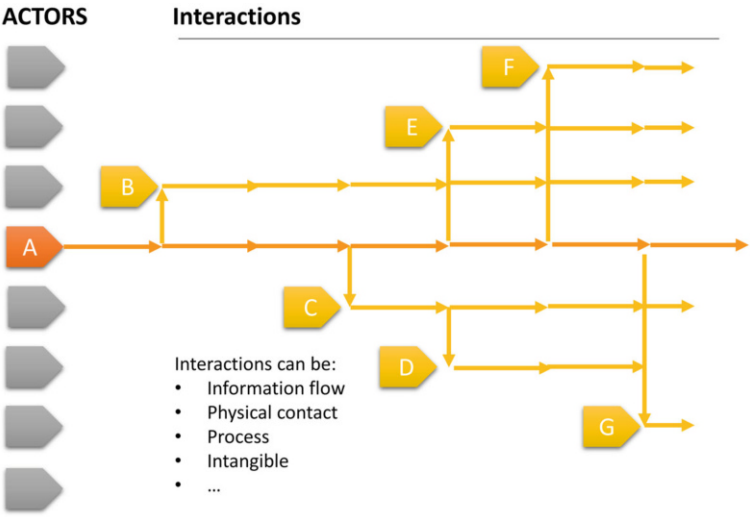


**Fig. 14.1** An iterative approach to explore stakeholders and actors starting with one key actor (A)

In such situations, an importance-based process exploration technique is applied. It starts by selecting an initial point, which could be, e.g., a person which seems to be relevant in the scenario (see Fig. 14.1 where the initial point is labeled "A"). Ideally, this point represents the start of a core process in the system to be modeled. From here on, we follow this process thread until it touches another process/resource/entity or actor (labeled "B" in Fig. 14.1). Starting from here, a second exploratory thread spawns—and so on and so forth. Following this procedure, we will be able to identify a sufficient collection of actors and entities while also unveiling (some of) the most relevant interactions and processes (including the support processes) to continue the system exploration. This collected information forms the basis for a subsequent series of expert interviews or focus groups in which the interaction of system entities and corresponding dynamics is analyzed. All the collected information will then be made available for further analysis by using a standardized notation supported by a digital tool, thus enabling a holistic understanding of the entire system and enabling a joint discussion with the identified key players and other affected people.

Such discussions usually take place in one or more workshops. In interactive sessions, missing aspects are added, and a shared common view is created by this means. In complex problems, which are difficult to comprehend fully, in particular, the standardized notation designed to reduce unnecessary complexity is very helpful. Throughout this phase, *EcoViz* is used mostly interactively, always providing a clear and tidy look at the entire model throughout the exploration, reflection,

and consolidation steps. While most meetings in pre-conceptual modeling are being held in person, *EcoViz* can also be used in virtual meetings for providing a central document when some or all participants join from different locations electronically—as, for example, during the Covid-19 pandemic.

Whereas this tool can be applied for exploring systems with a high degree of uncertainty and many unknowns, it is also very suitable in a contrary setting, where much existing knowledge and experience are available. Here it is often used to complement to existing tools in order to sort and analyze socio-techno-economic aspects in more detail. As described in [11], the tool can be used, for example, to refine and analyze ecosystems in the context of business model innovation including sustainability aspects.

Finally, it is important to mention that *EcoViz* integrates as one of the early tools into the conceptual modeling tool chain downstream by offering ways to export its entities, relations, and exchanged values.

## 14.3 Method Conceptualization

The $V^2$ notation used in the presented tool builds on the notation of Biem and Caswell [13], which synthesizes and extends concepts of e3 e-business modeling [6], c3-value method [8], and Allee's [7, 14] concept of intangibles [13]. The following section describes the $V^2$ notation structured around dedicated layers (see Fig. 14.2) which have been developed in the course of various research projects over the past decade [10–12, 15, 16].

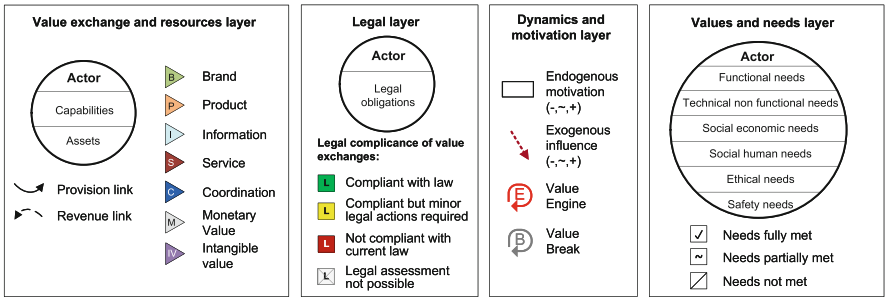


**Fig. 14.2** The analysis layers of *EcoViz* (figure from [11] based on [10, 12, 13, 15])

- **Value exchange and resources layer** [11, 12]: The value exchange and resources layer [11, 12] provides insights into the actors that participate in an ecosystem and the values they exchange from a resource-based perspective [17]. This layer builds on the notation of Biem and Caswell [13] and enhances it in selected aspects. Accordingly, the main building blocks consist of tripartite circles which represent **actors** [18] and directed arcs which represent **value exchanges** between actors [13].

  - Actors represent economic entities (e.g., organizations, business units, persons), which participate in an ecosystem. They are described by specifying their designation, capabilities (dynamic activities and processes that are contributed to the network by the actor), and assets (tangible and intangible things which facilitate the value generation of the actor) [13].
    Depending on the types and the numbers of actors involved, the clustering of actors with similar properties and semantics could become necessary for the sake of clarity. This kind of visual structuring can be realized with frames around groups of actors, dedicated labeling, or coloring.
  - Value exchanges represent the transfer of various types of values between actors [13]. The value exchange concept between actors defined by [13] builds on [6] and [19] and specifies various types of value such as "product," "brand," "service," "coordination," and "information" [13]. These types are complemented in $V^2$[12] by the value exchange types "monetary value" and "intangible value" as defined in [6]. Value exchanges in the direction of the end customer are termed provision links and are represented by solid lines, whereas revenue links are represented by dotted lines and indicate values received by actors in return for value provisions [11, 12].

- **Legal layer** [10, 11]: The explicit consideration of legal aspects during ecosystem planning and exploration phases is particularly important to ensure legal compliance of the resulting business ecosystem. The legal layer [10, 11, 20] of the presented modeling tool provides functionality for representing the legal obligations of the actors and to illustrate the level of legal compliance of the value exchanges. The value exchange and resources layer provides the basis for this layer by identifying the actors and value exchanges within the network. Legal obligations are summarized for each actor of the ecosystem in the corresponding actor symbol. Both legal obligations within an actor and value exchanges between actors are assessed according to the four legal compliance levels defined in Table 14.1. The legal layer of the tool can be used to explore legal compliance of planned ecosystems by illustrating complex legal network settings. It can also be used to assess the legal compliance of existing ecosystems or compliance of anticipated changes in existing ecosystems. A combination of the legal layer with the underlying value exchange and resources layer provides a shared view on the ecosystem from a legal and resource-based perspective and thereby facilitates cooperation in interdisciplinary teams [10, 11].
- **Dynamics and motivation layer** [11, 12, 15]: The dynamics and motivation layer [11, 12, 15] supports the analysis of value exchange relations and related dynamics of value generation in ecosystems. Positive dynamics in ecosystems may arise if loops of positive value-generating activities and value exchanges reinforce each other to form "value engines" and in the case of negative dynamics to form "value breaks." Anticipation of positive and negative value-generating feedback loops is based on the motivation theory by Vroom [21] and Porter and Lawler [22] by analyzing internal and external influences on the motivation of actors to contribute to value generation in the ecosystem. Endogenous motivation

**Table 14.1** Compliance levels of value exchanges as defined in [10, 11, 20]

| Symbol | Existing ecosystem | Planned ecosystem |
|---|---|---|
|  | The value exchange is compliant with legal regulations | The value exchange is compliant with legal regulations |
|  | The value exchange needs special attention (e.g., due to anticipated changes of legal regulations in the near future) | Minor actions (e.g., notification of the data protection board about planned data exchanges between actors) need to be done to be compliant with existing legal regulations |
|  | The value exchange is not compliant with existing law. Action required | The planned value exchange is not compliant with existing legal regulations, and an amendment of these regulations would be required to permit the value exchange |
|  | Legal assessment not possible at this project stage | Legal assessment not possible at this project stage |

**Table 14.2** Levels of endogenous motivation and exogenous influences as defined in [12]

| Level | Endogenous motivation | Exogenous influence |
|---|---|---|
| Defensive (−) | The agent performs the value activity only if it is not conflicting with his own goals. Employees give the least attention to the value network task | The external force discourages the value activity |
| Neutral (~) | The agent performs the value activity collaboratively in a timely manner. Tasks of the value activity have lower priority than personal tasks | The external force neither endorses, facilitates, nor discourages the activity |
| Active (+) | The agent performs and pursues value activity and collaboration actively. Tasks have either a higher than or equal priority than personal tasks | The external force actively encourages and facilitates the activity (e.g., special reward programs, management inquiries about project progress or performance) |

and exogenous influences on actors and their related value exchanges within an ecosystem serve as means to approximate these influences (see Table 14.2). Endogenous motivation describes the level of motivation of employees or persons within an economic entity (actor) to execute value-generating activities. As described in [12], endogenous motivation is based on the "expectancy theory" of Vroom [21] and determined by individual evaluation of the expected outcome for the person who performs the value-generating activity. Exogenous influence describes the external force on the actor which could foster or restrain the value-generating activities within an actor. As described in [12] (p.360), " [...] this concept is based on Kelman's [23] external influences on the compliance of a person and on Porter and Lawler's [22] extrinsic rewards as a consequence of the agent's performance" [11, 12, 15].

- **Values and needs layer** [11]: The values and needs layer [11] aims to particularly focus on sustainability aspects [24] of an ecosystem in the sense of the triple bottom line concept [25] which aims to create win-win-win situations for companies, customers, and the environment [26]. Hence, the values and needs layer also explicitly includes social and environmental dimensions of ecosystem analysis in addition to economic aspects. It thereby builds on the "values" concept of Breuer and Lüdeke-Freund [27] who differentiate the purely economic-focused concept of "value" from the "values" concept which also explicitly considers social and environmental dimensions of values and needs of actors. This is also represented in the definition of the notion "values" which "refers to what a person or group of people consider important in life" [28] (p. 2). The explicit representation and consideration of actors' needs and values as defined in Table 14.3 in this layer are intended to facilitate the creation of sustainable ecosystems [11].

  The insights gained with the analysis of the needs of actors provide the foundation to identify satisfiers [33] for these needs to ultimately create sustainable

**Table 14.3** Values and needs of actors for sustainable ecosystem analysis as defined in [11]

| Actor needs | Description |
|---|---|
| Functional needs | Needs for a specific functionality to, e.g., support in getting a job or a process done. According to Partsch [29], functional requirements define functional aspects of a system or what a system or process should be able to accomplish |
| Non-functional needs | Non-functional needs represent the human side of needs and can further be classified into: |
| Technical non-functional needs (TNFN) | Technical non-functional needs of actors which need to be fulfilled by the system or service such as handling and design of the user interface and quality requirements to determine the quality of the system (based on Rupp [30]) |
| Social economic needs (SEN) | Needs of customers (actors) in terms of how customers (actors) want to be perceived by others in economic terms, e.g., bragging and feeling better than others (based on the concept of social jobs in [31]) |
| Social human needs (SHN) | Needs of customers (actors) in terms of doing good to others or the environment. This aspect covers all three dimensions of a sustainable development including environmental societal and economic aspects, which need to be arranged in a livable, equitable, and viable way to create sustainable business models [32] (based on [24]). This aspect is thus focused more on a person's external environment in a societal, economic, and ecological sense |
| Ethical needs (EN) | The need to comply with an individual's (actor's) ethics theory [32]. In contrast to the aspect of social human needs, ethical needs are more person centric and focused on a person's ethical theory. For example, the ethical need for privacy is represented by the fact that an employee wants to know and determine what information about himself or herself is communicated to others (e.g., current location of employee in a plant) |
| Safety needs (SN) | The need for preserving the customer's (actor's) need for safety when using the service (e.g., work and consumer safety) |

and viable business ecosystems. The levels of matching between the needs and satisfiers can be rated as fully, partially, or not met (see Fig. 14.2), analog to the concept described by Gordijn et al. [34] primarily for economic contexts [11].

## 14.4 Proof of Concept

This section introduces the implemented proof of concept, termed *EcoViz*, based on [35]. *EcoViz* is intended for exploring, modeling, and analyzing business ecosystems in a (pre-)conceptual phase. It implements the $V^2$ notation and enables the user an interactive, dynamic modeling and analysis process. It enhances the paper-based method conceptualization of the $V^2$ notation by offering the user an easy-to-use multi-layer view for exploring different aspects of ecosystems. Furthermore, it places itself in the tool chain of (pre-)conceptual modeling tools by offering export functionalities of the generated ecosystem models.

The core functionalities of *EcoViz* are demonstrated in Sect. 14.4.1. Section 14.4.2 shows practical case studies where the introduced method conceptualization and the *EcoViz* implementation have been used.

### *14.4.1 Tool Functionalities*

The following subsections will introduce the main functionalities provided by *EcoViz*. The sections focus on the essential functionalities to enable a quick and easy modeling start for users. The theoretical background of the implemented notation is outlined in Sect. 14.3.

#### 14.4.1.1 EcoViz Environment

*EcoViz* (see Fig. 14.3) offers the user a model canvas (1) as well as an element toolbar (2). Furthermore, standard functionality is provided via the ADOxx modeling environment [36]. These are among others the model explorer (3), a navigator (4), a standard toolbar (5), as well as a menu bar (6) with standard and individual functionality offered by *EcoViz*. The items displayed in the main window can be customized by the user in the ADOxx environment.

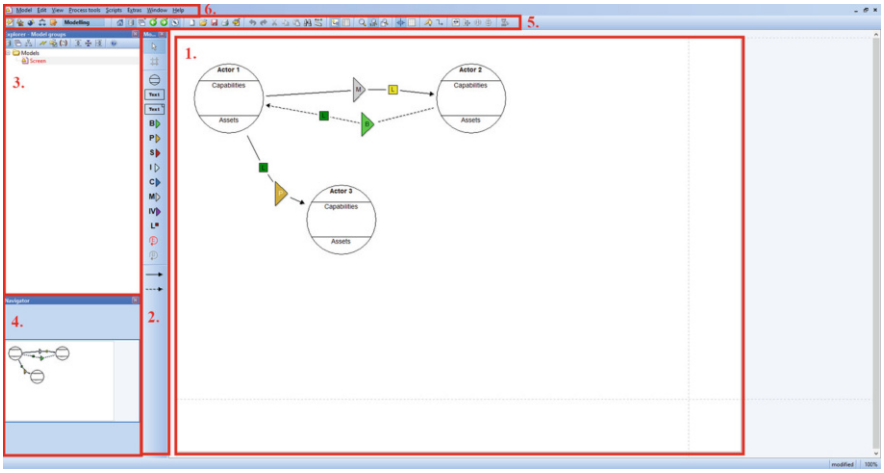


**Fig. 14.3** The modeling environment

### 14.4.1.2 Main Elements

The main insertion workflow in *EcoViz* is done by the user selecting proper elements which are offered by the notation in the element toolbar and adding them to the model canvas. All elements, containing actors, labels, text fields, and links, can be selected (mouse click on the element in the element toolbar) and inserted properly (mouse click on the model canvas). Depending on the selected element type, different inserting schemes have to be followed:

- To insert an actor, the user selects the actor element in the element toolbar and can then insert as many actors until the insertion process is stopped via a right mouse click (see Fig. 14.4). The actor element is a generic element which is offered just once in the element toolbar. *EcoViz* offers the functionality to switch the actor layer (see Sect. 14.4.1.7), so the appearance of the actor changes and attributes are shown according to the selected layer. For further details, please refer to the corresponding layer sections (Sects. 14.4.1.3, 14.4.1.4, 14.4.1.6).
- To insert links, the user first selects the type of link in the element toolbar and then the link source and the link destination on the model canvas (see Fig. 14.5). Links are unique, and there is thus only one link of the same type with the same source and destination. Links can be further described by adding textual descriptions using the attribute notebook for the link (double-click on link).
- To insert a value exchange or legal label, the user should select the desired label in the element toolbar and then select the link on the model canvas on which the label should be dropped.
- The insertion process for text fields and other annotation elements is basically equivalent to the insertion of actors.

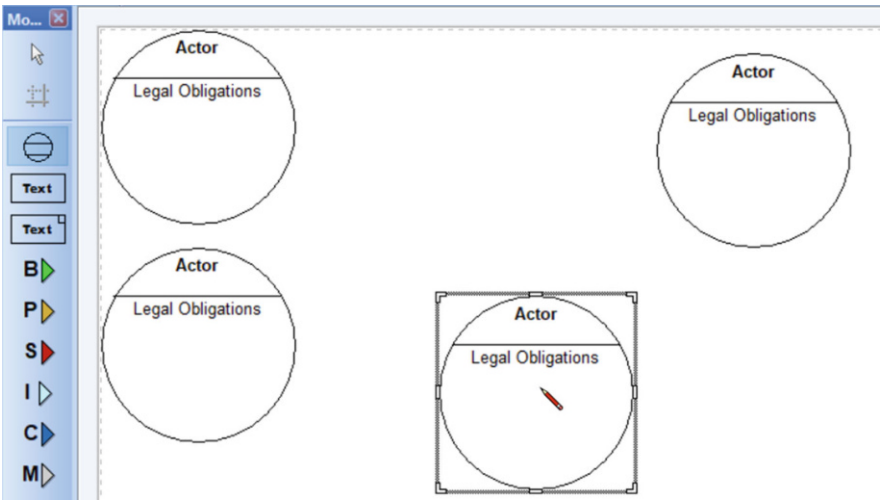


**Fig. 14.4** Adding an actor element

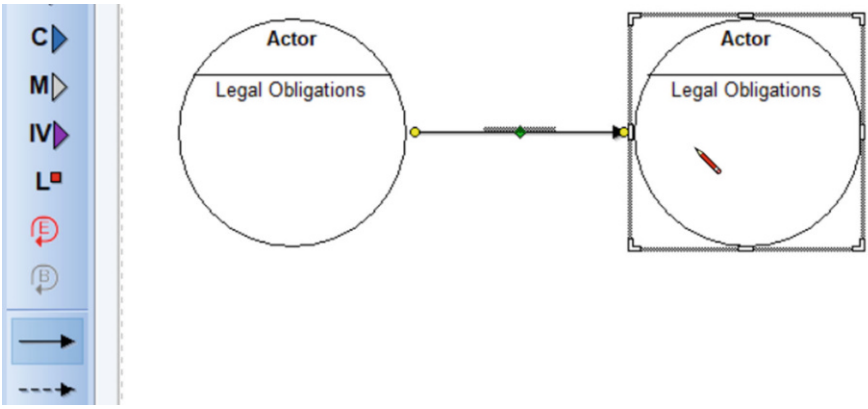


**Fig. 14.5** Inserting a link

#### 14.4.1.3 Value Exchange and Resources Layer

The user can drop value exchange labels directly onto connecting links between actors (see Fig. 14.6). Once dropped on the link, the labels can still be shifted among the link's arc, and they can also be deleted (attribute notebook). Labels have to be inserted directly onto specific links. The insertion of a label to the model canvas and the subsequent dropping of it onto a link afterward are not possible.

To interact with the value exchange and resources layer of an actor, the user can double-click on the name of the actor to fill in the name, capabilities, and assets of this actor via the attribute notebook.

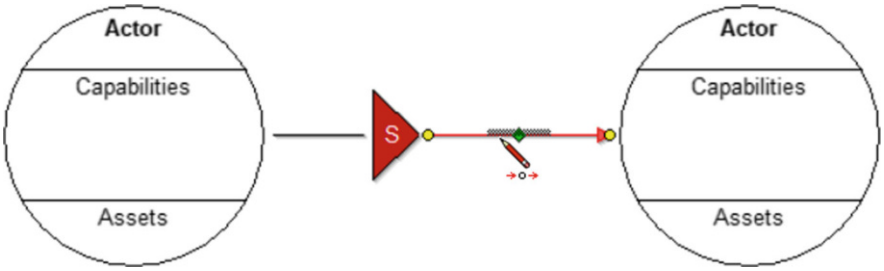


**Fig. 14.6** Value exchange label: Dropping a value exchange label on a link

#### 14.4.1.4 Legal Layer

The user can drop legal labels directly onto connecting links between actors. As these labels are following the scheme described in Sect. 14.3, the user can change the type of the legal label via its context menu (right mouse click on it, see Fig. 14.7) or in the attribute notebook of the relation.

To interact with the legal actor, the user can double-click on the name of the actor to fill in the name and legal obligations of the actor via the attribute notebook.

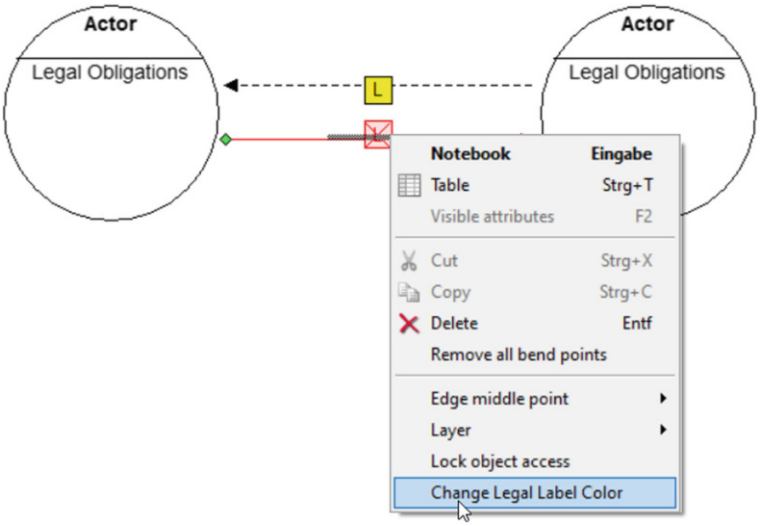


**Fig. 14.7** Legal label: Changing the legal compliance level

#### 14.4.1.5 Dynamics and Motivation Layer

To model the dynamics and motivational aspects, the user can use the corresponding elements:

- The value engines and breaks can be inserted as any other element and do not have further functionality.
- The endogenous motivation element is a text field which in addition allows the user to change the level of motivation a certain stakeholder offers. This can be achieved by a mouse click on the motivational level of the corresponding element.
- The exogenous influence can be inserted for each actor by ticking the checkbox in the attribute notebook of the corresponding actor. The level of influence can be altered by a mouse click on the exogenous influence link.

#### 14.4.1.6 Values and Needs Layer

The user can directly interact with the inserted values and needs layer of an actor. The needs as well as the actor description can be filled by the user via the attribute notebook which can be opened with a double-click on the actor's name. Furthermore, the grade of fulfillment of the certain needs can be set via a mouse click on the corresponding actor's need fields (see Fig. 14.8).

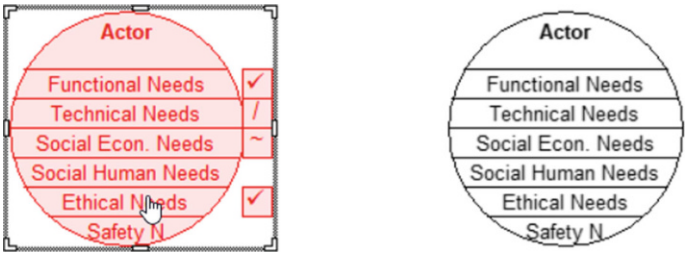


**Fig. 14.8** Actor values and needs: Changing the fulfillment grade of actor needs

#### 14.4.1.7 Layer Switching

One of the main advantages *EcoViz* offers is the possibility for switching between different views on ecosystems. Once different layers are modeled with their corresponding elements, the user can switch between the actor layers that are shown and also show/hide different label layers. This leads to a highly interactive modeling and analysis possibility which further enhances the understanding of ecosystems. The actor layer switching as well as showing/hiding layer elements can be done via an external script in the drop-down menu bar (see Fig. 14.9).

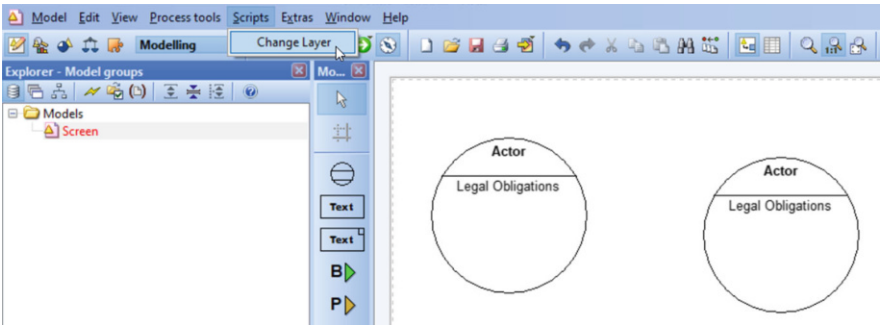


**Fig. 14.9** Changing the viewpoint (layer) on the modeled ecosystem

#### 14.4.1.8 Export/Import

*EcoViz* offers the ADOxx standard functionality to export the models in various graphical formats. To overcome barriers to different modeling and analysis tools, *EcoViz* offers the possibility to export models in a XML-based standard format of the ADOxx environment. This should ensure that further modeling tools can use the results from the ecosystem modeling and enable a different view on the generated data. The structured export can serve as a basis for further quantitative analysis.

### *14.4.2 Case Studies*

This subsection describes the application of the *EcoViz* tool in the context of four different case studies. The first case study concerns a 3D printer manufacturer aiming to enter the medical industry with a new product. *EcoViz* is used here to identify and analyze this new business ecosystem. The second case study describes the application of *EcoViz* in the context of a research project, in which a medical 3D printing center shall be integrated in a hospital. The third case study focuses on legal aspects when using unmanned aerial vehicles (drones) by authorities for search and rescue missions in alpine regions. The last case study, which was a workshop on mission-critical communications in Public Protection and Disaster Relief, demonstrates the use of the *EcoViz* methodology both on paper and as a digital tool for analysis and documentation.

#### 14.4.2.1 New Business Model for a 3D Printer Manufacturer

This case study describes the application of *EcoViz* in the exploration phase in the industry domain.

A 3D printer manufacturer, whose current customers are original equipment manufacturers (OEMs), tier 1 suppliers, and SMEs of various industries, wants to enter the medical industry market with a new product, a 3D printer for medical applications. The target of the case study was to support the development of a business model for this market. To support this, *EcoViz* was applied for the purpose of a detailed stakeholder analysis. The required data was gathered in a workshop with the CEO and the Head of Research & Development of our industry partner [37].

Application of *EcoViz*—value exchange and resources layer: The target of the application of *EcoViz* was the identification of all stakeholders and the long-term stakeholder values in the context of the new business. For this purpose, a simplified version of the ecosystem [13] was prepared with the help of *EcoViz*, using initial data from a stakeholder map [4], that was created in a previous workshop. This ecosystem was printed in a large format to be suitable for usage in the workshop. During the workshop, the values exchanged between the stakeholders were identified together with our industry partner. This was achieved by simply asking our industry partner to provide free-text answers to the question: What is exchanged between the actors on the chart? After the workshop, the ecosystem was digitized with *EcoViz* [37].

This digitized version is visible in Fig. 14.10. It includes all the identified actors and the values exchanged between them for the new medical business ecosystem of our industry partner. For illustration purposes, the values exchanged between the manufacturer and the key employees are highlighted. The values provided by our industry partner to its key employees are shown on the solid line. The dotted line conveys the values provided from the key employees to our industry partner [37].

The application of *EcoViz* was rated very positively by our industry partner. This partner stated that it would reuse the *EcoViz* tool in the own company. This would be done in particular for the purpose of developing cooperation, for activities that are related to sales, and also for evaluating new business areas [37].

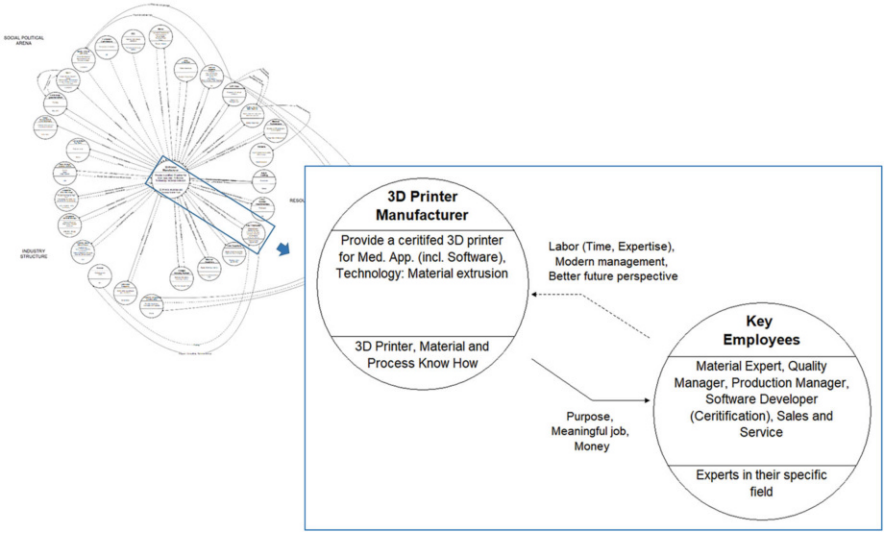


**Fig. 14.10** Output of *EcoViz*: The ecosystem of a 3D printer manufacturer's medical business ecosystem [37]

#### 14.4.2.2 Operation of a 3D Printing Center at Point of Care

This case study describes the application of *EcoViz* in health care. The *EcoViz* tool was applied in the reflexion phase in the context of the CAMed[1] research project. One target of this research project is the integration of a 3D printing center at the point of care to produce patient-specific medical products in the clinic [38].

Application of *EcoViz*—dynamics and motivation layer: The target of the application of *EcoViz* was to analyze the operation of the recently established 3D printing research center at the clinic. With the help of *EcoViz*, value engines and value brakes at current state of the operation are to be identified. The required data for analysis was gathered in semi-structured interviews. As an illustration for the interviewees, a simplified ecosystem of the 3D printing center at the point of care was created in advance with *EcoViz* (see Fig. 14.11). Based on this ecosystem, stakeholders were selected and interviewed for their opinions regarding exogenous influences and endogenous motivations of the actors of the ecosystem [39].

This analysis helped to reveal related dynamics of value generation in the ecosystem of the 3D printing research center. For example, Fig. 14.12 illustrates a value engine in the value exchange of the 3D printing research center and the scientific partners [39].

[1] CAMed (COMET K-Project 871132), which is funded by the Federal Ministry Republic of Austria Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK) and the Federal Ministry Republic of Austria Digital and Economic Affairs (BMDW) and the Styrian Business Promotion Agency (SFG)

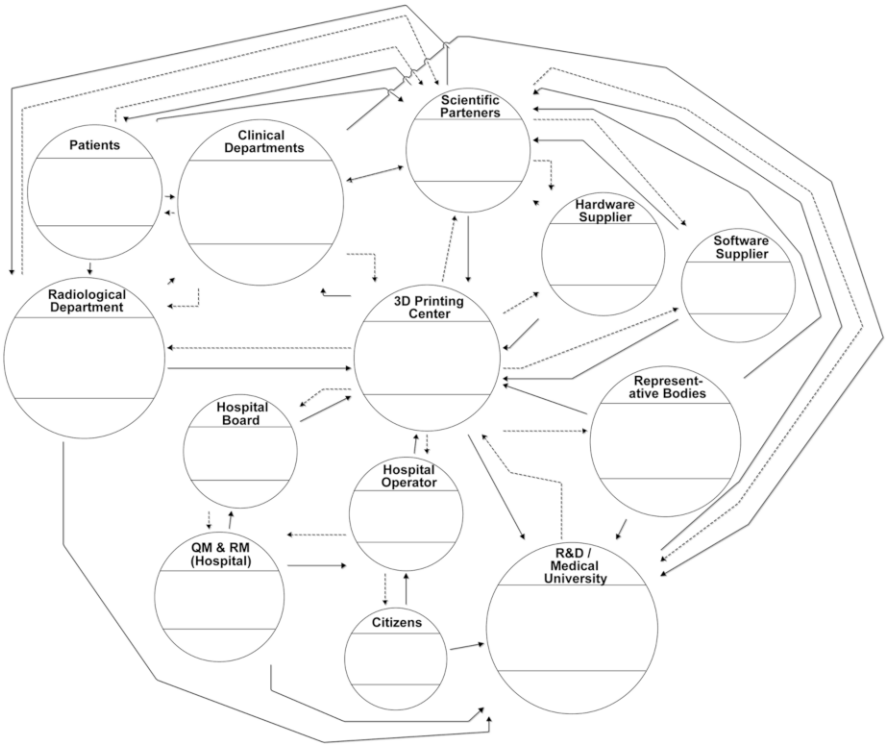


**Fig. 14.11** Output of *EcoViz*: The simplified ecosystem of a 3D printing center at point of care [39]

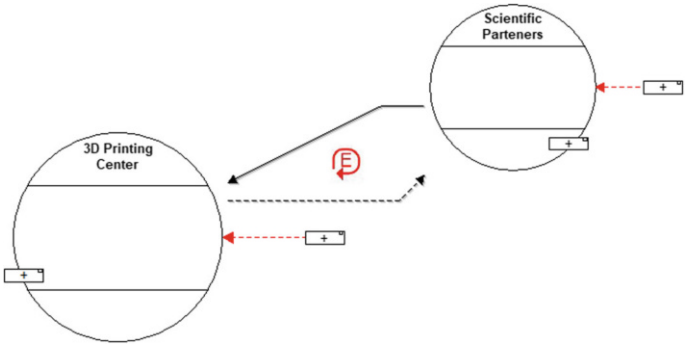


**Fig. 14.12** Output of *EcoViz*: Example dynamics and motivation—3D printing center at point of care [39]

#### 14.4.2.3 Using UAVs in PPDR Missions: Legal Aspects

In the project SmartScout[2], the use of unmanned aerial vehicles (UAVs) for Public Protection and Disaster Relief (PPDR) missions was investigated. One use case in the project was alpine search and rescue missions. Two different payloads were tested for this purpose, a thermal infrared and an optical camera. Particular attention was paid to legal aspects in the project, because it is essential to take various legal regulations into consideration in this context. One issue is to distinguish between private use and the use by the police. While a private person is allowed to do everything which is not forbidden by law, police forces are only allowed to do, to what they are empowered to. Furthermore, there are laws for the drone itself (aviation laws) and the information it collects (data protection laws) which have to be considered. A legal assessment was thus carried out using *EcoViz* and focusing on the legal layer. This was continuously updated throughout the project period in order to obtain more insights. The result of the legal assessment is illustrated in Fig. 14.13 [20].

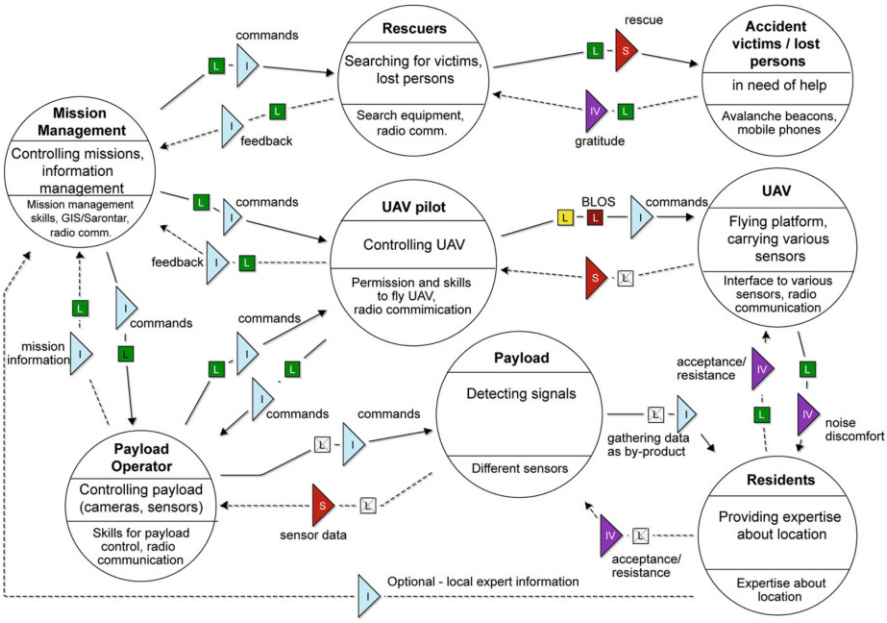


**Fig. 14.13** Legal assessment combined with value exchange relations of the planned information service [20]

[2] Austrian security research program KIRAS, Federal Ministry of Transport, Innovation and Technology (bmvit), grant number 854769

Regulations regarding UAVs are constantly changing, and with *EcoViz*, the model can be easily updated by adapting the status of law compliance.

#### 14.4.2.4 Using Mission-Critical Videos for PPDR: Workshop

During the Public Safety Communication Europe (PSCE) conference in Paris, December 2019, a workshop was held addressing the topic of "Mission Critical Videos for PPDR (Public Protection and Disaster Relief)—Benefits and Challenges." New possibilities are arising with the advance of technology, and these are opening up new ways of interaction that practitioners and first responders can use in exchanging information by using videos from, e.g., smartphones and drones.

The workshop had the aims of investigating ways of using mission-critical videos for practitioners, exploring different viewpoints and needs, and also discussing the emerging ethical issues. Participants were from police departments, emergency medical services, infrastructure provider, etc. from different European countries and also the United States. Groups of five to six participants were formed to work on the question of mission-critical videos, and they were accompanied by facilitators.

To find a common ground, the pre-conceptual modeling tool was used in a workshop setting. First, every team agreed on a specific use case, identified the important stakeholders, and wrote them on paper cards. For the workshop setting, paper cards were prepared for the stakeholders as well as a large sheet of paper for putting these all into relation with each other. Different colored pens were used to draw the relations for describing the exchange and the mode between the different stakeholders. No digital tool was used for the workshop.

Figure 14.14 shows the result of one group for a use case labeled "Construction Collapse" where inter-emergency services are called in to deal with a construction collapse. It is important to point out that due to the extremely operative environment, the decision was made to start initially with the analog version of *EcoViz* by using flip charts and pens and printed shapes from *EcoViz* and later transfer the results in digital form. The group identified 15 different stakeholders, among others, robot/drone operator, citizens (on scene), ROG (responders on ground), EMS (emergency medical services), ROG Fire, 911 dispatch, and media. One interesting aspect when using the tool was that it is important that the participants have a basic domain knowledge and a familiarity with the application area. Moreover, it is also important that the participants are aware of different meanings and wordings in different countries. Another point for intensive discussion was the transmission mode for provision and revenue links between the stakeholders: PTT (push to talk), video, data, and voice (phone). The group illustrated the modes by colors, and they partly categorized the links by type, e.g., live stream and coordination. The tool enabled a structured discussion and provided important insights.

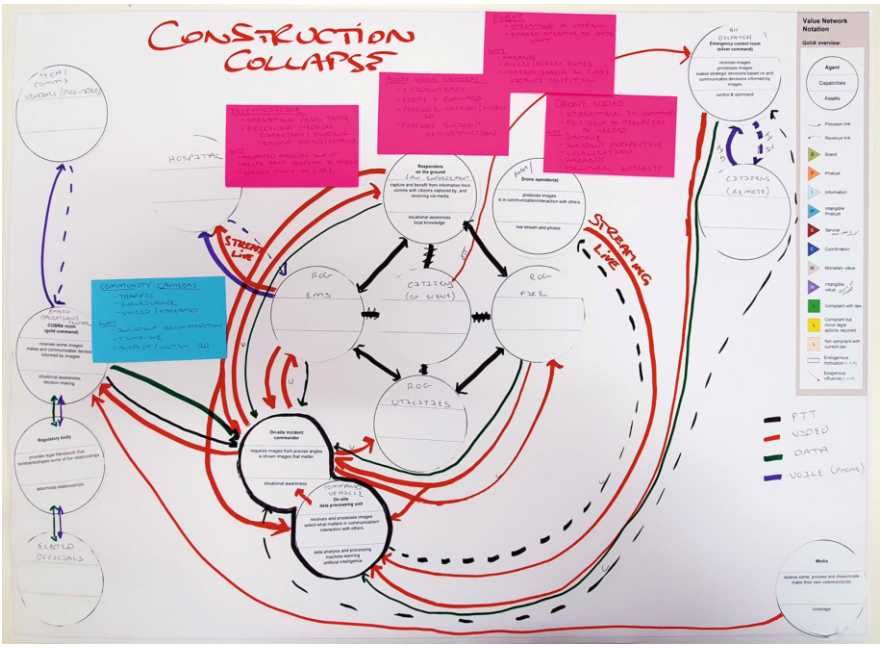


**Fig. 14.14** Phase 1: *EcoViz*—methodology (flip chart version): The ecosystem for mission-critical video

After the workshop, the elaborated ecosystem was transferred into the digital tool, as shown in Fig. 14.15, and could now be easily enriched with observations from the workshop.

## 14.5 Conclusion

*EcoViz* is based on a conceptual framework for mapping ecosystems, which was developed over many years. Its digital version was originally developed as a browser-based application [35] and later ported to the ADOxx platform. In many applications, *EcoViz* has proved to be a valuable tool in very early stages of (pre-)conceptual modeling at different levels of pre-existing information about the system.

- Systems with no or little pre-existing information, knowledge, or experience: For exploring systems where neither relevant actors, shareholders, nor stakeholders are known.
- Systems with some pre-existing information, knowledge, or experience: For putting existing information together and identifying and collecting complementary information.

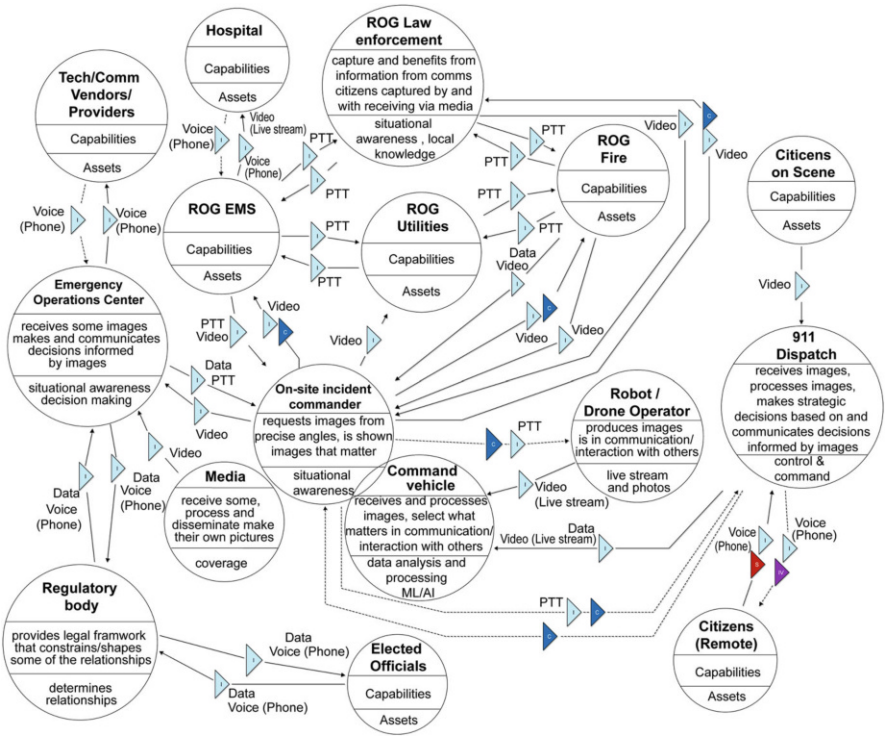


**Fig. 14.15** Phase 2: *EcoViz*—methodology (digital version): The ecosystem for mission-critical video

- Systems with a lot of available information, knowledge, or experience: For visualizing and analyzing complex system settings as well as interactions and thereby providing a basis for further exploration, communication, and discussion.

As described by Täuscher and Abdelkafi [40] (p.161) in the context of business model innovation, visualization has various positive effects on cognitive processes, for example, by "[. . . ] freeing up the working memory for other thinking processes [41] and [. . . it] structures the information [. . . ] to enhance the representation of relationships [42]." Visualization also facilitates communication within interdisciplinary teams [10], which is particularly supported by the layers concept of *EcoViz* that, for example, supports a unified view on legal and economic aspects of an ecosystem.

The layer-structured design of *EcoViz* allows switching between different layers and therefore allowing a focus on distinct aspects of the different layers. It supports the phase of structuring, analyzing, and gaining insights and knowledge and fosters communication. With *EcoViz*, complex issues can be presented in the context of other aspects, e.g., legal issues in the context of value exchanges or resources. On the one hand, it provides a good overview, and on the other hand, it offers detailed

insights related to different contexts, which allow a more holistic view to be made of the investigated system.

*EcoViz* also supports the generation of workshop templates which can be simplified versions of an ecosystem with only little information. Templates of this kind serve as a starting point for discussions and foster the creative generation of the ecosystem, especially when printed on paper in a large format (see Fig. 14.14 or [37]).

We have demonstrated the use of *EcoViz* on four different use cases from different scenarios. Practical experience has shown that *EcoViz* can also be very useful in the context of business model innovation [37]. We are currently using this tool in many domains and situations. Hence, we are continuously incorporating feedback and new findings and capabilities.

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**Tool Download** https://www.omilab.org/ecoviz

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