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Two requirements engineering techniques, *i** and *e³value*, work together to explore commercial e-services from a strategic-goal and profitability perspective.

The proliferation of service-oriented architectures is transforming more and more IT services into *e-services*—intangible products provisioned via the Internet, involving multienterprise, commercial transactions offering value in return for payment or something else of value. Email, Web-hosting services (ISPs), Internet radio, and customer self-service are familiar e-services, but nowadays more advanced e-services are emerging. Examples include online management of customer premise equipment—such as home-based routers, media centers, and computers—and full-service online markets and auctions.

Software engineers must first understand an e-service before they can build effective systems to support it. That means understanding its *business model*—the enterprise's goals and intentions that motivate the exchange of economically valuable things. Recent e-business history clearly shows that failing to understand the business model often results in short-lived businesses and sometimes even bankruptcy.[1]

In software requirements engineering, researchers have focused on the earliest stages of system development, exploring the business context in which the system will function. We apply systematic goal- and value-modeling requirements engineering techniques and show how they can help create, represent, and analyze e-service business models. Using *i** (distributed intentionality) modeling, we explore strategic goals for enterprises, and using *e³value* modeling, we learn how these goals can result in profitable enterprise services. We demonstrate our approach using a case study on Internet radio.

Internet radio

Consider broadcasting a radio program. If a radio station broadcasts music, it must pay money to an intellectual property rights society for each track listened to (*track clearing*). Additionally, the rights society pays most of the money to rights owners, such as artists and producers (*track repartitioning*).

In the "old world" (music broadcast via terrestrial transmitters), the rights society would have to use market research to estimate the number of tracks and listeners. By contrast, the "new world" (music broadcast via

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The *i** Methodology for Goal Modeling

Goal modeling aims to determine what various actors want and how (and whether) those wants will be achieved. *i** stands for distributed intentionality,[1] building on the premise that actors don't merely interact with each other through actions or information flows but relate to each other at an intentional level. They depend on each other to achieve goals, perform tasks, and furnish resources. While each actor has strategic goals to pursue, they're achieved through a network of intentional dependencies:

- *Goal.* A condition or state of affairs to be achieved. An actor can choose freely among different ways to achieve a goal.
- *Task.* A course of action to be carried out. It specifies a particular way of doing something, typically to achieve some goal.
- *Resource.* A physical or informational entity needed to achieve some goal or to perform some task.
- *Soft goal.* A goal without a clear-cut criterion for achievement, thus requiring further refinement and judgment. You might typically use this to represent quality goals.

Goals, tasks, resources, and soft goals help to analyze how actors relate; additional relationship types help to analyze the structure among these intentional elements:

- *Means-ends.* Shows a particular way (typically a task) to achieve a goal.
- *Decomposition.* Shows how an intentional element (typically a task) is decomposed into subelements, which can include goals, tasks, resources, and soft goals.
- *Contribution.* Shows a contribution toward satisfying a soft goal, typically from a task or another soft goal.

A *role* conveys the notion of an abstract actor. One or more agents, or concrete physical actors, can play a role.

Actors in *i** are strategic in that they seek relationships that will best suit their strategic interests. Dependencies offer opportunities but can also create vulnerabilities. Through the goal structures, you can construct and explore the space of alternatives available to each actor. We use a qualitative label propagation algorithm to interactively evaluate whether goals are achieved.[2,3] You can access related software tools at www.cs.toronto.edu/km/ome and www.cs.toronto.edu/km/openome.

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the Internet) allows the precise counting of music use if each listener reports track usage to a counting service. The listener's media player could do the reporting using Web service technology. Thus, intellectual property rights societies can set paying schemes for Internet radio stations to play tracks on a pay-per-track-per-listener basis (see www.riaa.com/issues/licensing/Webcasting_faq.asp for more information). This precision in the economic exchange requires services to be in place that can automatically charge Internet radio stations and pay collected money to rights owners. Given this scenario, e-service design faces two major complexities:

- First, a group of enterprises (radio stations and rights societies) working together provides the e-service rather than just a single company.[2] This lack of a single point of authority often results in complex decision making. Moreover, participating enterprises frequently lack a shared understanding of the e-services.
- Second, information systems design for supporting track reporting, clearance, and repartitioning becomes intertwined with business design: developers need to understand which enterprises and end customers are involved, what their commercial interests and motivations are, which things of economic value are exchanged between enterprises, and which constellations of enterprises deploying an e-service are likely to be profitable.

Internet radio presents a good challenge for e-services design. Just consider the changing landscape of music distribution: How should we exploit Internet radio's ability to precisely count the number of tracks listened to? Rights societies—for example, SOCAN (Society of Composers, Authors, and Music Publishers of Canada) in Canada or SENA (Stichting ter Exploitatie van Naburige Rechten) in the Netherlands—traditionally operate within a national scope due to the limited geographic reach of terrestrial transmitters. Now that Internet radio

The *e*³*value* Methodology for Value Modeling

The *e*³*value* methodology models a network of enterprises creating, distributing, and consuming things of *economic value*.[1,2] Here, we list the modeling constructs:

- *Actor*. An actor is perceived by his or her environment as an economically independent entity.
- *Value object*. Actors exchange value objects. A value object is a service, good, money, or experience, which is of economic value to at least one actor.
- *Value port*. An actor uses a value port to provide or request value objects to or from other actors.
- *Value interface*. Actors have one or more value interfaces, grouping value ports and showing economic reciprocity. Actors will only offer objects to someone else if they receive adequate compensation in return. Either each port in a value interface precisely exchanges one value object or none do.
- *Value exchange*. A value exchange connects two value ports. It represents one or more potential trades of value objects.
- *Market segment*. A market segment breaks actors into segments of actors that assign economic value to objects equally. Designers often use this construct to model a large group of end consumers who value objects equally.
- *Value activity*. An actor performs one or more value activities, which are assumed to yield a profit.
- *Dependency path*. Designers use a dependency path to reason about the number of value exchanges in an *e*³*value* model. A path consists of *consumer needs*, *connections*, *dependency elements*, and *dependency boundaries*. You satisfy a consumer need by exchanging value objects (via one or more interfaces). A connection relates a consumer need to an interface or relates an actor's various interfaces. A path can take complex forms, using AND/OR dependency elements taken from use case map scenarios.[3] A dependency boundary denotes the end of value exchanges on the path.

Given an *e*³*value* model attributed with numbers (for example, the number of consumer needs per timeframe and the valuation of objects exchanged), we can generate *profitability sheets* (for a free software tool, see www.e3value.com). Profitability sheets show the net cash flow for each actor involved and are a first indication whether the model at hand can be commercially successful for each one.

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stations have worldwide reach, how should we organize rights clearance? Who should musicians and producers rely on for representation internationally? Will there be sufficient revenue for all business actors?

As various types of intellectual content—music, video, e-books, and so on—are increasingly digitized and distributed over the Internet, business models will continue to evolve, attempting to balance the many stakeholders' competing interests and demands. Emerging Web services technology—such as SOAP, WSDL (Web Services Description Language), and UDDI (universal description, discovery, and integration)—by enabling automated interaction among dynamically configured business actors, creates numerous new possibilities for intellectual content distribution. Nevertheless, despite technical feasibility, only a small fraction of the possible architectures may turn out to be economically viable, so it makes sense to analyze the business model prior to system development.

Goal and value modeling

To better understand a multienterprise e-service offering, we use two complementary techniques. The *i** modeling and analysis technique (see the related sidebar) focuses on the question, what do actors want and how do they achieve that? We identify enterprise and customer high-level (strategic) goals and reason about goal dependencies and conflicts, including those between various enterprises.

The *e*³*value* technique (see the related sidebar) asks what enterprises are exchanging of economic value. Will each enterprise be economically viable? This might result in a business value model, clearly showing the enterprises and final customers involved and the flow of valuable objects (good, services, and money). Furthermore, the *e*³*value* technique provides for quantitatively analyzing the potential net cash flow of each enterprise involved.

Figure 1 shows how you can use *i** and *e*³*value* in combination to explore a multienterprise e-service offering. First, we create an *i** SD

(strategic dependency) diagram stating the enterprises participating in this e-service and how they depend on each other. Based on this *i** SD model, we develop an *e³value* diagram, focusing just on the actors and what they exchange of value. As with *i** SD, an *e³value* model containing only actors and their value exchanges, thereby concentrating on relations between enterprises. This is typically a first step in developing a multienterprise e-service.

Then, we construct an *i** SR (strategic rationale) diagram, focusing on internal enterprise interests. Next, we can add each enterprise's internal, value-adding activities to the *e³value* diagram. Understanding the value activities forms the foundation for a profitability analysis for all enterprises involved in the e-service. Then, *i** SR model can use the results from the profitability analysis because *e³value* quantifies many goals as profitability goals. The *i** SR model might show that not all enterprise goals are satisfied, which lets us modify and reevaluate the e-service idea. When all goals are sufficiently satisfied, we can proceed to the next stage of detailed information system analysis and design.

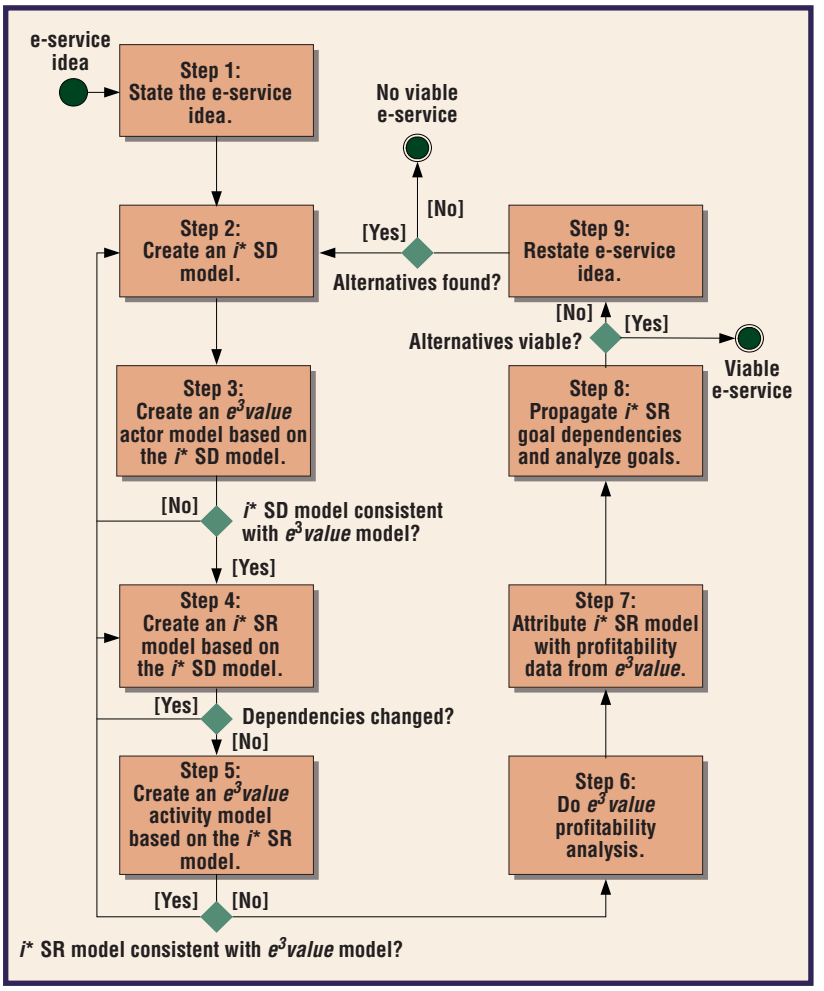
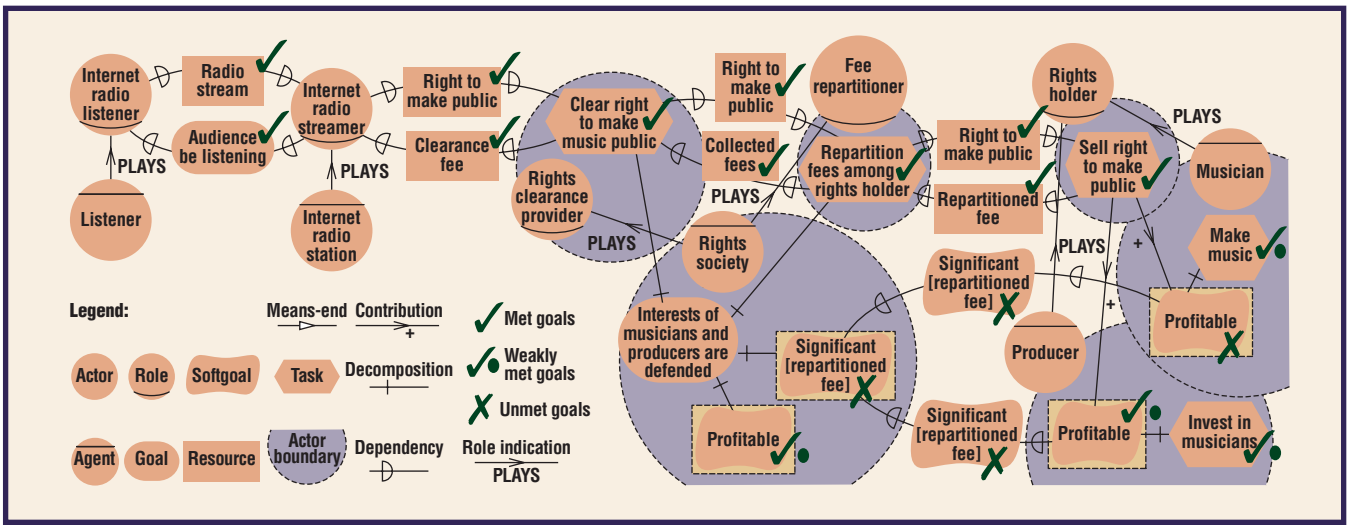


Figure 1. Exploring an e-service using *i and *e³value*.**

Goal analysis with *i**

We use *i** SD/SR modeling to examine the strategic motivations and rationales behind a value constellation's network of relationships. For example, a rights society aims to defend the interests of musicians and producers. In Figure 2, two tasks accomplish this goal, performed by the rights society's two roles: "Clear right to make music public" and "Repartition fees among rights holders." In accomplishing these tasks, the "Rights society"must itself be profitable (an internal soft goal) while produc-

Figure 2. The Internet radio service: Goal perspective.



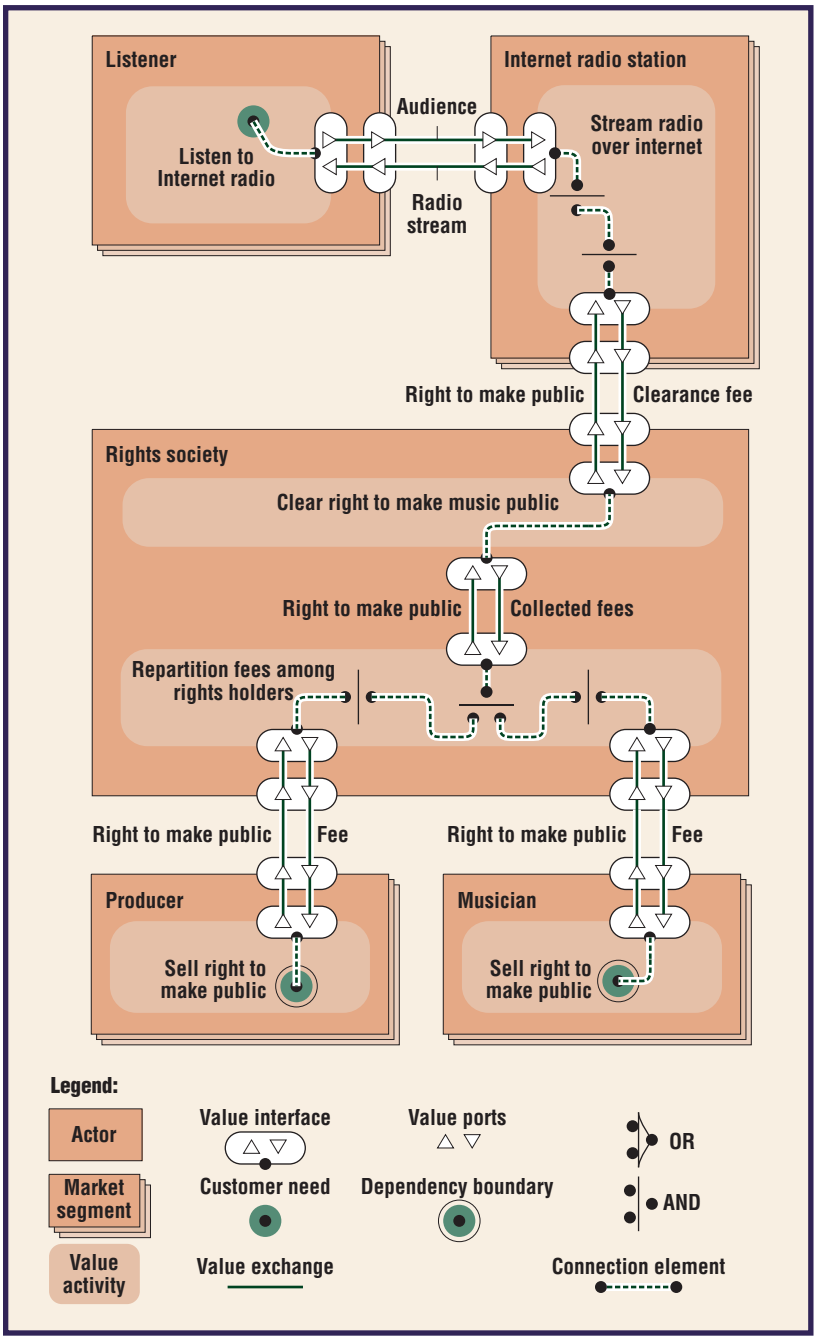


Figure 3. The Internet radio service: Value perspective.

ing "Significant repartitioned fees" for musicians and producers (dependencies from these actors).

We can use means-ends, decomposition, and contribution links to trace the relationships among actors to strategic goals. This allows us to locate sources of potential problems as indicated by the ✗'s (unmet goals). We can explore the space of alternatives by asking how else we can achieve the identified goals. A more detailed analysis would show synergies, conflicts, and trade-offs among a full range of goals such as market share, customer loyalty, reputation, investor confidence, long-term versus short-term profitability, and so on.

Value analysis using *e³value*

Based on the *i** SD goal model, we develop an *e³value* model, revealing actors exchanging things of value. After developing an *i** SR goal model, we extend the *e³value* model by showing the value activities that contribute to reaching the enterprises' goals. We need this level of detailing to reasonably estimate incoming and outgoing cash flows, based on an understanding of the enterprises' internal processes. In Figure 3, we model "Listener" and "Internet radio station" as market segments, indicating many listeners and many Internet radio stations exist. Listeners obtain a radio stream and, in return, give the radio station an "Audience." This audience interests the radio station because advertisers (not shown) sponsor the station depending on the audience size.

Each time an Internet radio station plays a music track, an Internet radio station has to pay a clearance fee. The rights society in turn repartitions a fee to rights owners, specifically "Musicians" and "Producers."

Interworking between *i** and *e³value* models

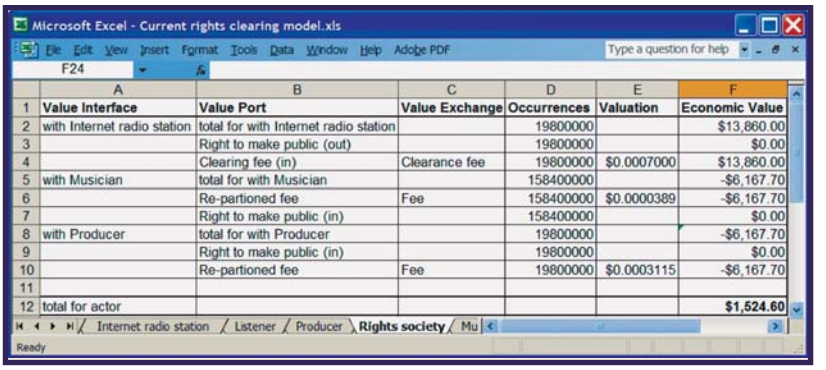
The *i** goal models complement the *e³value* models by revealing the strategic reasoning (*i**) behind the value exchanges (*e³value*). Using the notion of goals and soft goals as well as tasks and resources, *i** models cover a range of interests that actors in a constellation can pursue. The *e³value* models illustrate what economic value exchanges are taking place among which actors. By means of a *value interface* construct, the *e³value* technique emphasizes the notion of *economic reciprocity*. For example, "Rights society" exchanges with "Musician" a "Right to make public" and offers in return a "Repartitioned fee."

We offer guidelines for producing an *i** model from an *e³value* model and vice versa elsewhere.[3,4] For example:

- Actors and market segments in *e³value* are in *i** agents.
- Value exchanges between different actors in *e³value* are in *i** dependencies between roles played by agents.

- Value activities performed by actors in *e³value* are in *i** tasks performed by roles.
- Value exchanges between value activities performed by the same actor are in *i** dependencies between tasks.

The notion of economic value also links the *e³value* and *i** models. Agents in *i** have economic goals (for example, profitability) that you can satisfy by exchanging objects of value between actors, which an *e³value* diagram will show.



	A	B	C	D	E	F
1	**Value Interface**	**Value Port**	**Value Exchange**	**Occurrences**	**Valuation**	**Economic Value**
2	with Internet radio station	total for with Internet radio station		19800000		$13,860.00
3		Right to make public (out)		19800000		$0.00
4		Clearing fee (in)	Clearance fee	19800000	$0.0007000	$13,860.00
5	with Musician	total for with Musician		158400000		-$6,167.70
6		Re-partioned fee	Fee	158400000	$0.0000389	-$6,167.70
7		Right to make public (in)		158400000		$0.00
8	with Producer	total for with Producer		19800000		-$6,167.70
9		Right to make public (in)		19800000		$0.00
10		Re-partioned fee	Fee	19800000	$0.0003115	-$6,167.70
11						
12	total for actor					**$1,524.60**

Figure 4. Net-cash-flow calculation for the "Rights society."

Evaluating the models

In a networked business model, we can gauge overall success by each actor's ability to make a profit. Using a quantitative profitability analysis based on *e³value*, we can get an indication of whether the model satisfies profitability goals—on a per-actor basis.

To do so, we must attach attributes to the *e³value* model with a series of assumptions. Example assumptions include the number of listeners (an attribute of the market segment "Listeners"), the actual minutes per month listened (an attribute of the consumer need "Listen to Internet radio"), the price for track clearance per track per listener (as an attribute of the value exchange "Clearance fee"),[4] and more. On the basis of these assumptions, we can do a per-actor net-cash-flow calculation (see Figure 4); automated tool support is available (see "*e³value*" sidebar). Usually, you perform these net cash calculations for a number of years. For each year, you develop a value model. Each model represents a yearly snapshot of the net cash flows, which you can use in economic investment analysis tools such as Discounted Cash Flow (DCF)—supported by the *e³value* software tool—and Internal Investment Rate (IIR).[5]

Obviously, this calculation only takes into account known incoming and outgoing money flows. So, if the analysis shows that the e-service is potentially of interest for all actors involved, you might then further explore revenues and expenses—for example, by quantitatively analyzing business processes and the related information system (with respect to required resources such as workers[6] and IT investments and maintenance).

We use the financials in figure 4 to annotate the *i** goals in figure 2, with labels Met (✓), Weakly met (✓.), and Unmet (✗) as evaluation starting points (marked as yellow boxes). We propagate these labels through the *i** model using a qualitative labeling algorithm. The results show that some actors don't sufficiently meet their strategic goals—for instance, "Producer," "Musician," and "Rights society." So, the proposed initial e-service business idea won't work for at least three important actors, and it will require changes to arrive at an acceptable service—if it's possible at all.

Rethinking the business model

We're searching for an acceptable model for all actors; this differs from an optimal model. Given many enterprises' diverse interests, it might be difficult—if not impossible—to find such an optimization criterion. An optimal criterion for one enterprise might be suboptimal or even counterproductive for other actors.

The Internet radio model doesn't show a significant net cash flow for clearing rights, an activity the rights society performs. Overcoming this requires the number of listeners to significantly increase. We might do this by collecting fees on an international, rather than a national, scale. This, however, introduces the need for a national rights society to collaborate with rights societies from other countries. For instance, a track performed by Canadian artists, listened to in the Netherlands, requires the Dutch society SENA to clear the track if a Dutch Internet radio station broadcasts the track and the Canadian society SOCAN to repartition the track. This becomes even more complicated in the near future when radio stations and artists will be able to select any society for clearing and repartitioning their rights. So, a first issue in track clearance is to find which society clears a track for a particular artist. To facilitate this international dimension, we added a so-called "Clearing coordinator," who medi-

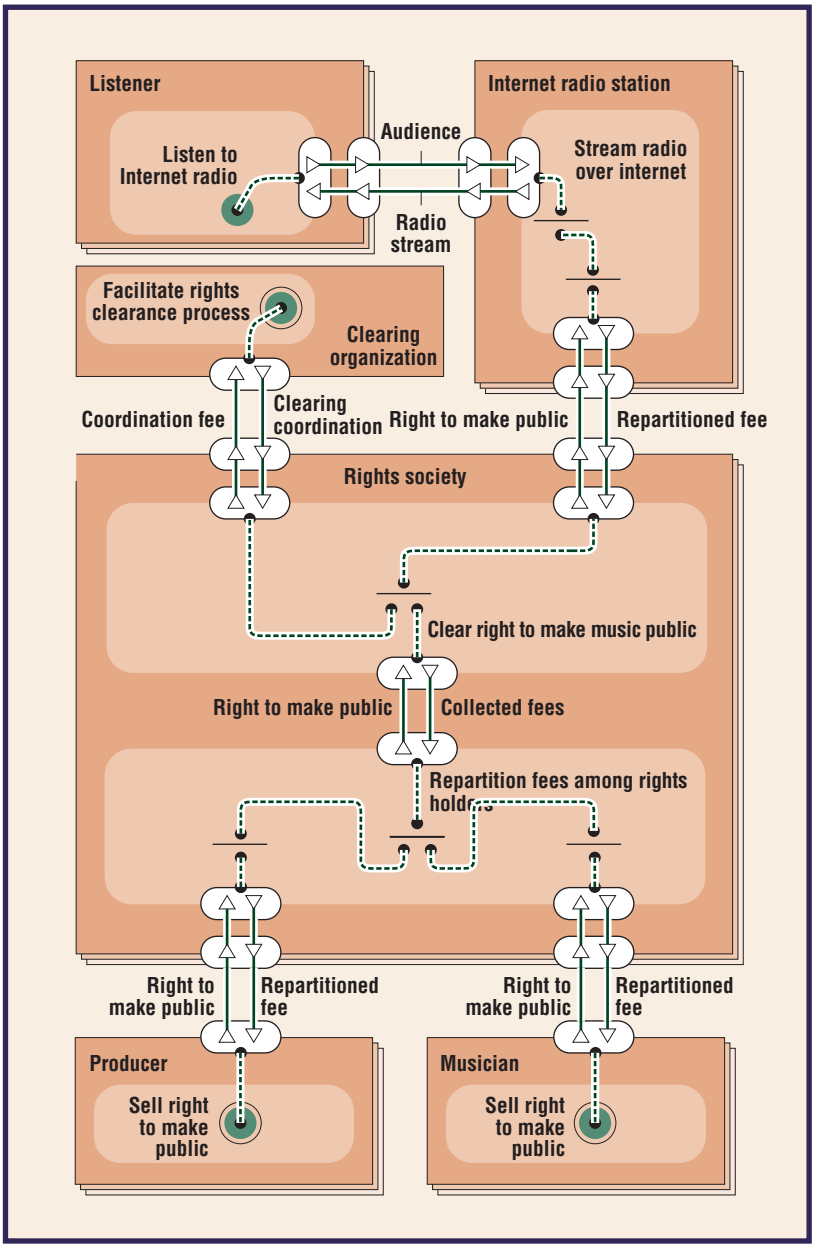


Figure 5. The international Internet radio service: Value perspective.

ates between societies and can be used as a look-up service to find the society clearing tracks for a particular artist. This mediation service is a service to the rights societies, not to the Internet radio stations. The stations still pay directly to a rights society; the coordinator has a facilitating role only.

Figures 5 and 6 show the resulting value and goal perspectives for this new, international service. The *e*^{3}*value* model shows the new "Clearing coordinator" actor, offering coordination services to all societies in return for a fee. Additionally, to show that we consider a series of country-specific rights societies rather than just one, we now mark "Rights society" as a market segment. From a goal-modeling perspective, the rights societies depend on the clearing coordinator in multiple ways. First, the clearing coordinator should enable Internet radio stations to find the rights clearing organization ("Discoverable [Rights]"). Second, the coordinator should increase the scale of operation for the country societies by taking an international scope ("International [Rights clearance]"). Finally, the coordination should contribute to lower transaction costs ("Low [Transaction costs]").

We should quantitatively evaluate the clearing coordinator model again to assess the *i** model's stated goals. We assume that, due to internationalization, a significantly higher number of listeners are participating.[4] Consequently, the monthly cash flow for societies increases significantly. Also, the coordinator itself can generate a sufficiently positive net cash flow. Importing the *e*^{3}*value* evaluation results into the *i** model and propagating the checkmark labels shows that this clearing coordinator model satisfies almost every goal, task, and soft goal; only the musician's profitability goal is weakly satisfied. However, certain mainstream musicians will receive a significant fee because their music is played much more often than average, thus allowing the profitability soft goal to potentially be achieved.

To be viable for business use, this e-services approach would benefit from additional analysis techniques—for example, to analyze how service bundles, provisioned by multiple enterprises, can satisfy complex consumer e-service needs.[7] From a business process and information systems perspective, further research is also needed on how to integrate value- and goal-oriented techniques properly with already existing interorganizational business process design approaches and with the design of Web services based on technology such as SOAP, WSDL, and UDDI.

Acknowledgments

We thank the Dutch rights society SENA as well as the Canadian rights society SOCAN for providing case study material.

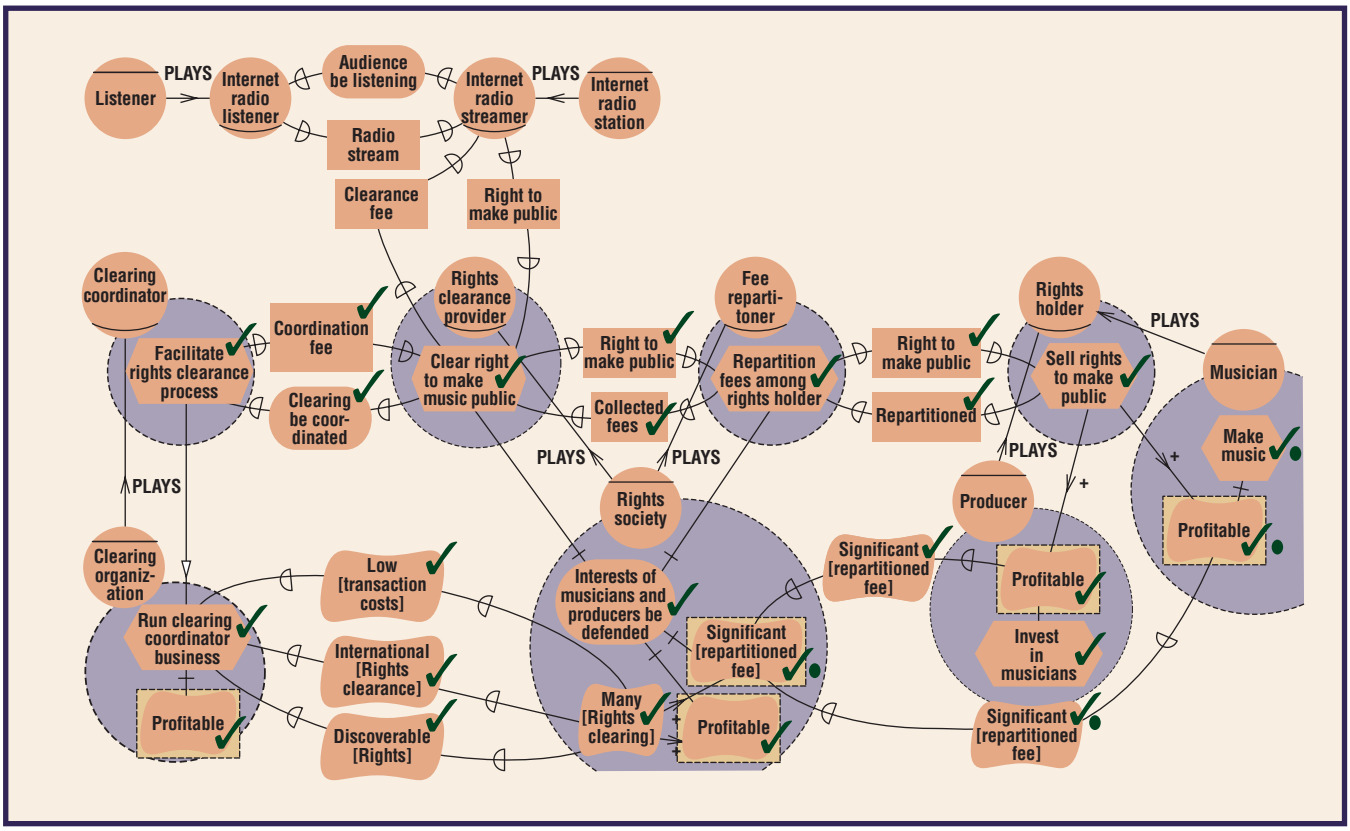


Figure 6. The international Internet radio service: Goal perspective.

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