

Cloud Computing in GILT Ecosystems and Evolution

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Abstract

With the ever growing volumes of dynamic content enterprises are faced with serious difficulties to handle, manage and analyze information in many languages and across different cultural boundaries. Therefore, there is a need to employ more open and collaborative approaches based on recent Web technologies and the concepts of utility computing to allow the existing language ecosystems to successfully evolve to the next generation of technology offerings. One recent innovation driver in this scenario is cloud computing. Cloud computing is the continuous development of a variety of technologies that can alter an enterprise's approach to build, maintain and leverage an IT infrastructure, for the language industry and the GILT service communities in particular, however, it serves as a next generation globalization enabler. It offers new ways of building, offering and delivering translingual services that will further transmute into transcultural services. This presentation will discuss the various emerging language ecosystems with new collaborative approaches and business models based on cloud computing technology platforms.

1 Introduction

In a recent MT Summit paper (Andrä and Schütz, 2009), we have introduced our vision of a future GILT¹ marketplace which resembles very much the concept of a natural life ecosystem as a kind of true “semantic network” that is designed to provide and capture data, information, structures and various relationships in self-referential units with built-in feedback capabilities, and real-

ized in a way to maximize upon the most “popular” routes through the relational links as a reflection of GILT community use case scenarios. Our vision resulted from an analysis of the current language industry, and in particular the GILT industry, which is mainly characterized by its slow technological innovation adoption policy and by its boundedness to meanwhile inadequate business structures such as translation cost calculations, which are still word-based, and translation quality assessment and evaluation strategies, which after more than a decade of discussions are still not specified in a real usable form and for different translation project types. On the one hand, some of the translation technology vendors argue that it is up to the customer to demand or to push for the use of new technologies, while on the other hand, customers argue the opposite.

Today, this situation gets even more severe with the ever growing volumes of dynamic, user-generated content in many languages and across different cultural boundaries with which large, medium and small enterprises are faced, and that need to be thoroughly digested – handle, manage and analyze – to serve as a valuable source of market and business strategies and decisions.

In this scenario, there is an urgent need to employ more open and collaborative approaches that are backed with recent Web technologies and the concept of utility computing to allow the existing language landscape to successfully evolve to the next generation of technology offerings and associated services. Recent innovation drivers in this scenario are cloud computing on the technology side and crowdsourcing on the human or social side.

In the following sections, we first shed some light on the concept of cloud computing and recent developments in this area, and what this computational services paradigm and infrastructure concept in tandem with crowdsourcing opens

¹GILT stands for Globalization, Internationalization, Localization and Translation.

up for future GILT ecosystems. After a brief discussion of the general methodological aspects and the baseline technical architecture of such ecosystems and their potential use cases, we present a succinct and critical reflection on the role of the Open Source Software (OSS) paradigm and of standards with a particular emphasis on open standards in these ecosystems, and how they fit with already existing translation infrastructures and frameworks. The paper closes with concluding remarks and some recommendations for future inhabitants and colonists of GILT ecosystems as users in their roles as consumers and contributors as well as providers of services and services developers.

2 Emergence of GILT Ecosystems

2.1 Cloud Computing Revisited

Cloud computing is a term that has been hyped up in many ways and so far with no collectively understood definition. Cloud computing is basically the continuous development of a variety of technologies that have come together to alter an enterprise's approach to build, maintain and leverage an IT infrastructure in terms of single or combined services. These services have long been referred to as Software-as-a-Service (SaaS), and the data center hardware and software is what we call a Cloud. A Cloud that is made available in a pay-as-you-go manner to the general public, we usually call a Public Cloud; and the services being sold is utility computing. In contrast, the term Private Cloud refers to internal data centers of a business organization, and in general is not made available to the public. Thus, cloud computing is not only the collection of SaaS, utility computing and virtualization – SUV for short – which are integrated in a service-oriented infrastructure either in the form of Infrastructure-as-a-Service (IaaS) or Platform-as-a-Service (PaaS). In addition to these three elements, which constitute the cloud computing services stack, an actual deployment in an organization must be backed by a thorough commitment to change and transformation in order to fully take advantage of the economies of scale and multi-tenancy and to reduce the cost of using information technology resources.

It should be noted that this lightweight deployment model has already led to a “Darwinistic” approach to business development where beta versions of software are made public and the market

decides which applications deserve to be scaled and developed further, or to be quietly retired.

As of this writing (September 2009), cloud computing has further matured, and today even standardization efforts are going to emerge with recent developments such as those of VMware, for example, the vCloud API. It is not yet perfect, and it does not cover every case, but it is reasonably clear, and it is reasonable good enough for most IaaS providers to adopt now. More importantly, it is apparently easy to extend. Another important standard to keep an eye on is the vCloud competitor from the Open Cloud Computing Interface (OCCI) working group at the Open Grid Forum (OGF). More on standards and in particular open standards is provided and discussed in Section 4.3.

2.2 GILT Ecosystems

For the language industry and the GILT services communities in particular, cloud computing, serves as the next generation globalization enabler because it opens new ways of building, offering and delivering translingual services and technologies that will further transmute into real transcultural services.

In addition, it will also allow the masses to easier employ various language technologies on demand from everywhere and across time zones, and to contribute to further enhance and reshape services and the underlying technologies through crowdsourced activities. Utility sources can be machine translation services, terminology support and other language related services that range from simple lookup and management facilities to sophisticated exchange capabilities through agreed upon or even standardized interchange formats, in ways and with quality promises that were previously only available to industrial users. To bridge the gap between theory and practice the crowd would also need tools and the knowledge of how to use them effectively. Today, this phenomenon is already demonstrated by language service provider (LSP) practices when deploying Internet services such as the Google Translators Toolkit in traditional translation projects.

In this context, we talk about language ecosystems and more specifically about GILT ecosystems because these terms describe adequately the evolutionary character of the emerging online landscape that includes multi-faceted collaborative and community-driven markets and their spe-

cific crowdsourced demands and requirements besides the industrial main stream developments. In our MT Summit paper (Andrä and Schütz, 2009), we have thoroughly discussed the emergent and stigmergic aspects of this landscape, and here, we just summarize the main characteristic features.

These characteristics in particular make the approach distinct from other approaches, even those that already deploy SaaS and virtualization technology in SOA² environments, because it allows for effective improvements of quality and performance through the employment of adaptation, correction and (self-) learning capabilities.

The ecosystem approach is economically viable because of its apparent overall cost effectiveness as a cloud computing application, and being potentially based on business models that could extend to satisfying the “long tail languages” markets by opening the cloud applications to the mass markets, for example, as a translation-on-demand service with attached quality tags for the general public.

A successful cloud services architecture in terms of application re-architecture requires disruption to the status quo, and is not simply a matter of deploying new technology and building service interfaces to existing applications; it requires the redesign of the application portfolio. And it requires a massive shift in the way IT operates. You might compare this situation with the introduction of SOA because the small group of organizations that has seen real gains from SOA did so by treating it as an agent of transformation. If one wants real visible gains, then one needs to make a thorough commitment to change. Here, crowdsourcing enters the stage that with its adaptability contributes to making the process pervasive and powerful, and to being a phenomenon of creative destruction in near real time.

2.3 Market Challenges and Opportunities

Although machine translation and language technology services and systems are cost effectively deployed by very large, globally operating companies, the masses of small- and medium-size companies are handicapped by the accompanying financial investments and the necessary human resources for such systems.

Therefore, a GILT ecosystem allows in particular small and medium companies to benefit similarly and effectively from various automated lan-

guage tasks, and to enter successfully new markets, which would not have opened because of the existing language barriers.

A GILT ecosystem is an important challenge to demonstrate the advances in developing real computational intelligence that can learn and adapt to altering demands and needs. The compensation of costs and the continuous improvement of services quality through advanced leverage of sophisticated technologies together with new business models that also include open source software models and the collaboration between cloud computing services providers and customers are the ingredients of the economy's future driving forces.

Besides reducing the setup and management cost of an application that is associated with cloud computing resources, there are other advantages. For example, when a company separates itself from its resources by the Internet, it does not really matter where those resources reside. They could be, for example, in a location that offers appropriate terminological mining know-how in a certain domain and therefore minimizes application usage.

In the current economic crisis, the language industry, in particular the GILT market, is one of the exceptions for which analysts still forecast an increasing growth by a minimum of approximately 5 % per year within the next 5 to 10 years. However, such a healthy growth can only be achieved if a balance between language services demands and actual costs can be given so that through the investments in language services not yet another critical factor is introduced. Apparently community efforts and new, innovative technologies besides the already existing ones are needed to allow industries – small, medium and large – to master the multilingual language threat.

New dynamic technologies in a virtual translation automation space then is the main innovation driving force of a GILT ecosystem which comprises several horizontal and vertically organized translation automation related services on an industrial scale with associated different language resources that effectively support and efficiently facilitate these services. In addition, the services are also enablers of translingual and transcultural communication as well as of knowledge management systems because they add essential value to business intelligence and predictive analytics solutions.

²SOA stands for Service-Oriented Architecture.

In summary, GILT ecosystems based on the cloud computing paradigm are the consequent further development of already existing SaaS offerings in the area of translation automation process and workflow management that most often integrate translation memory and terminology service capabilities. These applications easily extent to offerings with affordable direct access to machine translation and other language technology services with value-adding built-in quality assessment and quality assurance functions at different levels for the industry and the crowd.

3 Methodological Aspects and Technical Architecture

3.1 GILT Ecosystem Baseline

The primary services and technology ingredients of any GILT ecosystem, which constitutes a “semantic network” landscape of differing agendas and approaches, are for instance:

- Content creation with negative translatability indicators to effectively support the human and/or machine translation process.
- Horizontal and vertical terminology governance to ensure terminological consistency and reliability in source and target information.
- Linguistic and cultural governance to assure quality as an information end-user experience.
- Translingual assets management including information and data sharing across domains and applications to efficiently support different re-use capabilities.
- Process and workflow management to effectively handle information and knowledge access and distribution.
- Machine translation integration management and workflow monitoring to supervise automated translation tasks.
- Machine translation output assessment and validation, and its revision in dedicated post-editing environments with feedback coordination and management to ensure and assure different quality requirements.

- Human and machine feedback lifecycle management to allow for effective and continuous quality improvements.

Today's translingual business activities comprise manifold processes in and around the proper translation workflow that need to be supported by software tools and services in a transparent, coherent and efficient manner to ensure effective quality and process management, and to efficiently enable additional business intelligence and predictive analytics applications as well as the integration of consumers and producers as active contributors and collaborators. At least three dimensions – process, matter and form which are the essential dimensions of any ecosystem – are mostly important to accomplish the vision of a complete ecosystem.

The first dimension (process) represents the entire workflow which also includes pre- and post-translation tasks that deal with processes such as content creation and optimization, glossary handling, proofreading, legal approval, and specific market adaptations in terms of content, form and function. The second dimension (matter) depicts the different information sources that deal with a specific subject matter in various publishing and presentation formats and linguistic realizations such as marketing brochures, web pages, training documents, technical descriptions, workshop manuals, and the huge amounts of valuable user-generated content. The third dimension (form) reflects the management of the information's life cycle in terms of its evolution in creation, translation, adaptation, assimilation and dissemination.

In addition, today's global communication processes demand for an easy deployment of tools and services, and their worldwide accessibility as well as a seamless interaction with other systems either through connecting existing techniques together, combining processes that are based on different techniques into an overall architecture, or extending and augmenting core techniques in various ways. These demands require the effective support of standard exchange and interchange formats, and the provision of secure, open and powerful interfaces. Although these demands and requirements are not directly related to the most often quoted business goals for the translation process, namely time, cost and quality, our experience proves that a strict support of the three dimensions plus the fulfillment of the additional demands and requirements are enablers to save time

and money, and to assure and continuously enhance translation quality.

In a sustainable GILT ecosystem, the offered services and their various combinations are fully customizable according to the specific demands and requirements of a service user including the leverage of the user's feedback, and there is no need to follow any pre-defined process or integration flow. Each service is independently deployable and offers appropriate interfaces so that these services might also work in tandem to build more complex system incarnations that would offer capabilities beyond the summation of the single service capabilities because a complex ecosystem is not just the sum of competences and performances of its components and agents. Imagine, for example, the emergent power of a collaborative system that integrates machine translation, post-editing and translation memory services with feedback cycles to assess and improve the service output quality in a certain domain.

The introduced primary ingredients of the GILT ecosystem fuel at least the following capabilities to name just a few:

- Ability to effectively distribute and manage centralized and decentralized resources of GILT related applications horizontally and vertically to ensure a semantic footprint across different quality levels.
- Fostering teamwork between humans and machines based on collaborative community platforms and on collective intelligence and emergence-based computational models to accelerate the sharing of resources across domains and to collaborate with users and partners to fulfill specific goals in the language product lifecycle, which across all industries including the GILT industry itself traditionally have been separated, such as: content creation including (source) language proofing as an initial linguistic quality assurance, glossary setup with horizontal and vertical sharing, translation proper including translation memories and machine translation deployment, proofreading including machine translation post-editing, and linguistic quality assurance based on, for example, industry standards, as well as information assimilation and dissemination with inbound and outbound machine translation.

- Beating competition in resources and technologies with emergence and stigmergy based services.
- Improving products and services through automated learning – unsupervised and supervised – and self-repairing methods as well as crowdsourced approaches.
- Accessing services on demand, at anytime and from anywhere.
- Providing transparent measures for validating service quality in terms of performance and competence.

These capabilities can be adapted vertically to efficiently support specific application domains and industrial settings, and they provide horizontal services across applications by

- Offering access statistics and predictive analytics to answer questions such as “What is missing?” to facilitate effective and efficient service arrangements.
- Acting as an early warning and alert system to allow the tracking of, for example, questions such as “Where and why is quality endangered?”. This also includes certain error or quality failure prevention activities.

3.2 Further Components and Services

A very important area of a GILT ecosystem is the broad field of terminology which comprises several sub-services that are necessary for an effective employment of domain-dependent vocabularies in different application scenarios, although it is often claimed that terminology is just a matter of “plug and play” which is an entirely false statement. These services include for example:

- Discovery and extraction of terminology.
- Management of vocabularies including quality validation.
- Import and export from external and internal resources with quality assessment and validation.
- Role-based access from other processes and services across system boundaries.
- Domain and context dependent usage control.

- Effective marketplace with sharing, bartering and crowdsourced capabilities based on well-defined or agreed upon interchange and quality rules.

Translation proper is also more than a single service application; it is a series of several services that collectively facilitate inbound and outbound translation tasks. These services include:

- Automated pre-editing that eliminates certain errors in the source language information.
- Integrated translation asset management including the selection of the most appropriate machine translation engine for a specific translation request based on meta-information, as well as the gathering of further additional training data for automated translation trainers if statistical means are employed.
- Automated post-editing that corrects certain machine translation errors.
- Marketplace for crowdsourced translation assistance with a challenging incentive's model to determine what it takes to engage, recruit, motivate and reward the crowd for a long-term involvement.

Given these application scenarios, any GILT ecosystem may at least distinguish the following three main employment roles:

- *Provider:* The provider is the owner and operator of the infrastructure.
- *User:* The user is the consumer and the active actor of the services with particular demands for competences, privacy and quality.
- *Vendor:* The vendor sells specific products and services that facilitate the delivery, adoption and use of inherent ecosystem applications such as machine translation, language quality proofing, machine learning for classification purposes, and so on.

A further area for a healthy evolution of the ecosystem are standards which we discuss in Section 4.3.

Another very important area comprises machine translation (MT) systems that will evolve to

the next generation MT systems based on machine learning techniques and computational intelligence to facilitate

- Automated knowledge discovery tasks such as the clustering and classification of information entities from feedback cycles.
- Collaborative behavior to ensure and to assure fixed and volatile quality measures used for validation and evaluation purposes.
- Effective self-learning and adaptable processes and functions.

4 Meeting the Needs and Demands of Evolution

4.1 Globalization Management Framework

As an example, ontram – the Online Translation Management Framework of Andrä AG – has been designed and implemented with these fundamentals as its leading architectural and development guidelines, and has given evidence in several large-scale industrial projects over the past seven years that the concept of an entire webbrowser based translation process management system that also can be deployed as a cloud application – in this case SaaS – has exceptional advantages in achieving the translation related business objectives of different companies.

ontram's webbrowser based open approach fully scales with the various business needs and demands of translation projects, and therefore medium and large enterprises and even small organizations benefit from its employment in the translingual value chain. In the following sections we look at several directions to extend and amend such a system towards our vision of a sustainable cloud computing based ecosystem by bearing in mind that the downgrading of demands and requirements can be accomplished much easier than their effective upgrading along the introduced three basic dimensions of an ecosystem, and show how the existing framework is able to eventually evolve into a fully fledged ecosystem that also resembles the six principles of a “living system” which are inspired by the work of Fritjof Capra (Capra, 1996; Capra 2002):

- *Network:* Systems are nested with other systems to form networks of networks. The

boundaries are not boundaries of separation but boundaries of identity. The systems communicate with one another and share resources across their boundaries.

- *Cycles*: An ecosystem consists of a continuous flow of matter and energy with actually no net waste.
- *Energy*: In nature the sun stimulates the production of chemical energy through photosynthesis.
- *Diversity*: Ecosystems achieve stability and resilience through the richness and complexity of their ecological webs. The greater their diversity, the more resilient they will be.
- *Cooperation and partnership*: The exchange of energy and resources are sustained by pervasive cooperation and networking.
- *Dynamic balance*: An ecosystem is a flexible, ever-fluctuating network. Its flexibility is a consequence of multiple feedback loops. No single variable is maximized; all variables fluctuate around their optimal values.

The means to achieve these principles in a GILT landscape together with a certain crowd-sourcing trigger and momentum are:

- Connecting to even competing products and systems to form a function and resource sharing network across existing system boundaries.
- Data exchange and recycling with complementary products and systems to form a complete whole, or to enhance each other, for example through (highly) specialized products and systems, and the leverage of horizontal or cross section information and knowledge aspects as samples of larger groups.
- Hosting of services cloud networks to support internal and external governance as well as evangelists, sponsors and investors.
- Connection to different products and systems to facilitate the hosting and the de-

ployment of commercial systems and of open source systems.

- Providing and supporting interfaces and APIs together with open standards and the cooperation between independent software vendors, such as, for instance, anti-virus software vendors in the security industry.
- Development, support and integration of self-learning, adaptable systems and components with built-in appropriate feedback capabilities and interfaces.

In classical IT landscapes, these means are often achieved through open source software platforms, open standards and various community-based measures to ensure and to assure privacy and security of data and information, as well as overall trust and quality of the provided tool and service offerings. So the question for us is: Can we achieve similar results with these means in a GILT environment?

4.2 Open Source Software

When we look at open source, we are immediately confronted with information talking about the benefits of open source code, the ability to get quality assurance testing and code contributions from the community and, of course, the great benefits of having thousands of developers and users of your software instead of just tens.

However, do we actually have these masses in the GILT world? If we look at ongoing open source initiative examples, such as FOLT (Forum Open Language Tools) with its open source translation memory system OpenTMS, Open LOGOS in the field of machine translation, or GlobalSight the open source Globalization Management System of the LSP company Welocalize, then the numbers of real active contributors is quite disappointing or at least discouraging at a first sight. This is different in other fields such operating systems, application servers, programming languages, or even business process modeling and business intelligence in which the open source approach clearly helps innovation to move at lightning speed, and faster than any enterprise model, even with unlimited venture capital, ever could.

What is the difference between these applications and the GILT applications? What are the internal and external impacts on the different communities? First and foremost, the actual GILT

end-user communities are apparently very heterogeneous and at least currently smaller and obviously less skilled in IT applications than in the other domains. This situation is only changing slowly with new university curricula that integrate various translation technology aspects and new professional orientations into the education of future translators and interpreters. For software vendors, an open source approach changes many things internally but also helps them to improve their product in many ways because the open source model requires to deliver a product that a user can download, install and use without ever having talked to someone at the providing company. This means that upfront there is no consulting, no training, no on-site visits and no particular support or IT services are involved. This, however, makes it difficult for the GILT user community to adopt an open source product. A very good example to demonstrate this is to look at real successful deployments of the Moses statistical MT engine: Although there have been many, many downloads only some few LSPs have mastered a successful installation and use of this MT technology approach. Many vendors talk of these services as one part of their offerings but the open source model should drive you to a completely different level of “simple and easy”. Clearly, the services cloud approach fits perfectly in this context.

If we want to let both open source and commercial developers use core components of translation technologies, we also have to decide on an appropriate approach and to choose a certain license model, for example, the Mozilla Platform License (MPL). MPL seems to be an appropriate basis for a GILT product related software license because it makes the code available for extension, customization and integration with proprietary software and gives intermediate distributors and integrators the freedom to choose their own licensing model.

Moreover, in the GILT context, a hybrid approach seems to suite best the requirement to keep the source code for some of the components of translation technology freely available for the open source community to build upon, and to provide access, copying, modification and free distribution rights. Other components would be open only to technology partners or certain key account customers, and essential core components are entirely closed. In such a hybrid scenario,

MPL is also an appropriate license model because MPL is recognized and accepted by the open source community, and it is suitable for software that also includes other open source technologies licensed under various non-copy-left licenses such as the Apache Software License or the LGPL.

4.3 Open Standards

Clearly, interoperability and open APIs are necessary in any sustainable, collaborative GILT ecosystem to fully employ the community forces.

Interoperability means the ability of information and communication technology systems, as well as of the business processes they support, to exchange data and to enable the sharing of information and knowledge. This network-based approach requires a great effort in order to define rules of collaboration, coordination of processes, formats and specifications, as well as instances acting as brokers between systems.

Fundamentally, for the first 3-5 years, rapid innovation does not necessarily need standards immediately, and standards might even inhibit the adoption. In the next phase of any innovation effort, however, there is a distinct fear of lock-in, which sometimes leads to standards, sometimes interoperability concerns lead to standards, but eventually, the industry consolidates in this phase and standards typically emerge such as it had been the case with SQL in the database field. In the next phase to follow, there is another period of growth, but vendors find new ways to create lock-ins, for example, the stored procedure languages in the database world.

So the question is, what about cloud computing, and in particular GILT and cloud computing? At the moment, our hypothesis is the following: First, the different layers of the cloud infrastructure stack are in different phases. The bottom is more amenable to standards such as the Open Virtualization Format (OVF). Second, one particular version of the middle tier is then in the focus, i.e. the version that is pushing for a new “stack” such as force.com, the Google app engine, Amazon S3, and many others. However, another version of the middle-tier, which is taking traditional three-tier apps and moving them to the cloud is already well past the standards phase, because these applications have meanwhile made their decisions on database vendors as well as web application server vendors.

In addition, in the GILT context certain lock-in events such as the patent claim of Facebook for their translation crowdsourcing approach are counter-productive for a healthy growth of an ecosystem. Nevertheless, the community will certainly solved such potentially negative issues.

Standards that, on the one hand, consist of a number of already existing, typically lightweight, open standards which facilitate the execution of the services and apply to areas such as application, client, infrastructure, platform, service, storage, and so forth, and on the other hand, resemble language and translation related standards such as content related standards as for instance DITA, XSL, and XLIFF, and translation related standards as for example TMX and TBX, as well as content unit related standards which support the identification of linguistically meaningful units as for instance the XML Text Memory tagging, and others must be critically analyzed to validate their maturity and their potential to further evolve with future demands and requirements.

4.4 Privacy, Security, Trust and Quality

We may regard the GILT ecosystems with their cloud computing backbone as an ideal way for companies to better leverage their language assets and to control their GILT costs, but how do we actually measure and validate that these services take care of the privateness and the secureness of the data and the processes? Many people are skeptical about these aspects. What are the considerations and the steps that must be taken when we trust our data to the cloud, and what can we do to keep our virtual infrastructure and web applications secure?

Until now, cloud computing security has been sorely lacking, but this is changing with the steadily increasing services offers such as:

- Data security and storage in the cloud, including appropriate measures for validating confidentiality, integrity, and availability.
- New and improved identity and access management practices for authentication, authorization, and auditing of the users accessing cloud services.

These offerings will further evolve because security management frameworks and related standards are relevant for the cloud, and because of a better understanding of the privacy aspects we

need to consider in the cloud, and how they compare with traditional computing models.

In addition, the awareness and learning of the importance of audit and compliance functions within the cloud, and the various standards and frameworks to consider must be in the focus of GILT education, as well as elaborating and examining approaches that deliver security as a service as yet a different facet of cloud computing security.

Because these GILT ecosystems create new additional questions about privacy, security, trust and quality in general, which might be not yet in the discussion focus and which might even evolve with future deployment scenarios, we always have to critically reflect on these aspects, and what the given flexibility that allows different dynamics means for these systems in terms of the traditional values of “create, patent and license” that have dominated intellectual property for the last decades.

5 Conclusions and Recommendations

To start with, an integrated, easy to use web-browser based and SaaS deployable Translation Management Framework, such as the ontram ASP Edition, provides many advantages for the whole translation and adaptation value chain across different media and all uses of language data, and presentation and publishing formats. If the involved parties all work on one online platform, this system, on the one hand, leads to optimized processes by means of cost, time and quality, and on the other hand, gives total transparency to the processes and their content.

A fully fledged GILT ecosystem can only be achieved if the system is capable and consequently supports an open interchange with other systems and information sources and targets. ontram demonstrates in a consistent and industrial proven way how these findings have been realized in a complex but still easy to use webbrowser based application. In its next evolution stages, however, the system must further prove how it effectively integrates, for example, machine translation capabilities that work together with the already existing components, modules and services in an adaptable and emergent fashion and in an ecosystem deployment scenario, thus allowing companies for additional savings, revenues and even new market gains.

Within the next 3 to 5 years, we will see more and more developments towards the GILT ecosystem vision because

- All aspects of cloud computing that we have discussed further mature at lightning speed.
- Sensitivity for crowdsourcing in different incarnations and consequent language data sharing increases.
- New markets and market opportunities emerge, including the ability to even reach the long tail of GILT activities.
- Language technology developers join in and their systems evolve to the next generation tools and utilities through offering feedback enabled interfaces for humans and machines.

This future certainly will bring us more distributed, crowdsourced markets in which social negotiation and collaboration between humans and machines are stigmergically mediated by computational intelligence and web-based technologies.

Our recommendation for future GILT ecosystem consumers as users and as contributors is:

- Actively collaborate and bring in your specific expertise and knowledge to the emerging communities and marketplaces.
- Be open minded towards crowdsourcing and its evolving power.

For future GILT ecosystem services providers, vendors and developers our recommendation is:

- Grow communities around your offerings, products and services.
- Do not entirely rely on standards but help to improve existing ones, and provide effective support to continuously enhance the quality of services as a user experience.
- Develop technologies with emergent behavior and provide systems that learn and adapt through the employment of computational intelligence.

Last but not least it should be mentioned that the overall idea of a networked collaborative marketplace is not brand new; it was already introduced and prototypically applied in an industrial setting over a decade ago (see Schütz, 1996a;

Schütz, 1996b and Schütz, 1997). Nevertheless, today's technologies have further matured, and we have an active social momentum through the global Internet communities.

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NOTE: Some of the following references are accessible through <http://www.mt-archive.info>. Thanks are due to John Hutchins, who maintains the Machine Translation Archive.

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