3 Impasse de la Gare
34260 St Etienne Estréchoux France
info@transformationsociety.net
+33-6 72 40 37 60

Hybrid Communication for Industry 4.0: Nemetic Models

Ray Gallon, The Transformation Society, France/Spain
Neus Lorenzo, The Transformation Society, France/Spain
Michael Josefowicz, The International Nemetics Institute, USA/India

1. INTRODUCTION

The increasing diversification of interconnected media platforms, which provide a complex discourse, has led to the concept now called “transmedia,” a term that in 1991 was used by Marsha Kinder to describe a new media supersystem, using intertextuality and diversity of sources with different levels of interaction (Kinder, 1991). The concept is open enough to incorporate media that had not been invented then, such as wearables, bionic implants, or augmented reality technology. Industry 4.0, a term coined by the German government, extends this idea beyond media, into the realm of hybrid communications in a world of autonomous, interconnected objects mediated by artificial intelligence (Wikipedia, 2017).

This article focuses on the relationships between hybrid communication environments and skills that will be needed to work in Industry 4.0. It also provides models based on the nemetic system, which are useful to analyze, track, and represent hybrid interactions in extremely digitalized environments.

The transmedia narrative inherent in social media (Dena, 2009), where content is spread across many platforms with varying degrees of interaction among multiple authors and multiple audiences, already adds complexity to the fragmentation of content (Steinberg, 2012) that McLuhan (1994) identified early on as a characteristic of mass media. When machines are added into the mix as intelligent agents in these dynamic interactions, we add a new set of complexity layers, where part of the cross-media content is not directly readable by humans. Eventually, much of these connections and messages will be unknown, untracked, and invisible to human beings.

For people to function in Industry 4.0, they will need skills well beyond the traditional listening and reading, and even beyond the new skill of transliteracy, understood as the ability to communicate across a range of platforms, tools and media (Thomas, 2005). They will need to be able to determine appropriate modalities and strategies for coding and decoding new types of multi-discourse:

- Human-human
- Human-machine / machine-human
- Machine-machine

Recent research explores cognitive patterns in narrative that can be represented through geometric models (Duarte, 2014). These recursive communication experiences have been described as “fractal narrative,” in terms of individual discourse (micro level), collective interaction (meso level), and community knowledge building (macro level).

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Explorations of the fractal essence of digital discourse by Mark Frazier and Spiro Spiliadis (described linguistically as "EBDish" – Emergent-By-Design-ish), and further investigations with Daniel Durrant and Michael Josefowicz (Frazier, 2010), have concluded that any symbolic language to express the new hybrid communication processes should also consider recursivity, reiteration and complexity in the analysis and visualization of complex interactive communications ecosystems. The Nemetics model offers a set of transferable codes to identify, quantify and represent, through communication channels:

- Individual mental processes
- Collective interaction
- Social resonance

(De, 2014).

2. CHALLENGES: TURNING POINTS

2.1 From Transmedia to Hybrid communication

In 2003, following up on Kinder, Henry Jenkins described "transmedia storytelling" as a collection of fragments in which "each medium does what it does best, so that a story might be introduced in a film, expanded through television, novels, and comics, and its world might be explored and experienced through game play" (Jenkins, 2003). He defined transmedia storytelling as a communicative sequence "where integral elements of a fiction get dispersed systematically across multiple delivery channels for the purpose of creating a unified and coordinated entertainment experience" (Jenkins, 2007).

The notion of multiplatform narrative is now expanding to include human/machine communication, in all present and future configurations. These hybrid communications introduce not only new codes, but new behaviours that emerge from the new ecosystem.

We understand this ecosystem as a complex network of networks that integrates Industry 4.0, powered by artificial intelligence (AI), and the new relationships that humans and machines will develop in this scenario. In this landscape, objects interact continuously, exchanging data they have picked up via sensors, and adding them to the global pool of Big Data. Interconnections bind intelligent objects together, to create a virtual copy of the physical world where enriched data captured from sensors is aggregated to higher-value contextually tailored information (Gallon and McDonald, 2016). The future vision is an extremely complex hybrid reality where humans and machines will develop communities and networks in dynamic clusters of interests, acting both individually and collectively, embedding their experiences in a constantly changing communicative context.

To study this complexity, we have depended primarily on traditional scientific disciplines for analyzing language, communication, and conduct, and we tend to represent behaviours according to what we have identified as legal rights and duties, as defined in existing institutional structures. Both combined are insufficient to compose models for understanding the superposition of three main levels of complexity:

A: Data and Information – Dealing with Artificial Intelligence Agents

Software agents work with data and metadata they extract from databases, human agents, context sensors, and other devices to produce adaptive information exchanges that function like a personal assistant. They have some capacity to learn as they acquire more data and compile it into information, and use natural language interfaces, written or spoken. Current examples include chatbots, SIRI, Google Assist, or Amazon Echo. Linked together in the Internet of Things, these agents will aggregate big data to determine hierarchies of content, context states, and visualization tools. They will also create priority protocols for network access based on the importance of different communications.

B: Interaction and Singularity – Recognizing Artificial Intelligence Personas

More than agents, these are real robots – software only or a combination of hardware and software. They are powered by deep learning engines such as IBM's Watson or Google's DeepMind. These robots are capable of making independent decisions, and of learning from their environment and context. That means that each robot is an individual, with different characteristics that can be likened to a personality. The logic of this leads to the notion that such robots have a status in society, with duties and rights. They form relationships and participate almost as robot citizens. This is echoed in a proposal for legislation from the European Parliament that proposes

> *creating a specific legal status for robots, so that at least the most sophisticated autonomous robots could be established as having the status of electronic persons with specific rights and obligations, including that of making good any damage they may cause, and applying electronic personality to cases where robots make smart autonomous decisions or otherwise interact with third parties independently.*
>
> *-(European Parliament Committee on Legal Affairs, 2016, article 31-f)*

The same document suggests that robots (or their owners) might also have to pay income taxes or social charges based on their economic value and contribution. This is a response to the possible impact on employment that widespread development of these robots can have.

The primary characteristics of these robots include individuality, and thus, taken collectively, a certain diversity. They acquire social knowledge, and exist as parts of a variety of communities that include human and non-human members. They narrate and differentiate their own experience to instrumentalize it for their own function: for example, instead of TV channels telling you if their programmes are appropriate for a given age group, your intelligent TV agent will provide your family with appropriate programming as a function of the people watching it.

This decision-making power implies that machines and networks must also respond to, and be responsible for, ethical principles. The European draft legislation envisages a "Charter on Robotics" that defines a code of ethical conduct in the field:

> *The proposed code of ethical conduct in the field of robotics will lay the groundwork for the identification, oversight and compliance with fundamental ethical principles from the design and development phase.*
>
> *The framework must be designed in a reflective manner that allows individual adjustments to be made on a case-by-case basis in order to assess whether a given behaviour is right or wrong in a given situation and to take decisions in accordance with a pre-set hierarchy of values.*
>
> *The code should not replace the need to tackle all major legal challenges in this field, but should have a complementary function. It will, rather, facilitate the ethical categorisation of robotics, strengthen the responsible innovation efforts in this field and address public concerns.*
>
> *Special emphasis should be placed on the research and development phases of the relevant technological trajectory (design process, ethics review, audit controls, etc.). It should aim to address the need for compliance by researchers, practitioners, users and designers with ethical standards, but also introduce a procedure for devising a way to resolve the relevant ethical dilemmas and to allow these systems to function in an ethically responsible manner.*
>
> *-(European Parliament Committee on Legal Affairs, 2016, Annex to the Motion for a Resolution)*

C: Accepting Artificial Intelligence Collectivities

In the hybrid-connected world of Industry 4.0 and beyond, very large networks will be formed by digital identities that will include robot citizens and human beings, linked in virtualized connections in an Internet of Everything. Intelligent objects, singularly and in groups, are weaving interconnections with people, whether or not they are connected via mobile terminals, wearables, implants, or prostheses. These networks will cluster together to form very complex networks of networks that make today's Internet seem simple. These clusters will be highly dynamic, with continuously emergent information that is shaped and reshaped every moment as a function of the person, object, or situation it is addressing. Responses and responsibility will be determined by the environment and context, according to the ethical, social, economic, and personality strategies that different entities have acquired through programming or learning.

Gallon and McDonald (2016) provide an example of how this can work involving a jogger in a shopping centre:

> *You pass a shoe store (part of a national chain) in a shopping centre – Sam's Shoes). Your terminal knows that you bought your running shoes six months ago and, based on your time spent running and wear calculation, deduces you could buy a new pair. Correlating with the store, it finds your brand and model on sale there, and alerts you. If you are jogging, it will have the store send an email, and the store decides to include a voucher.*
>
> *It's not going to alert you about Sam's Shoes national sale. It triggers THIS Sam's Shoes to suggest you buy the SAME shoes, on sale NOW, because your phone deduced YOUR CURRENT SHOES ARE ABOUT TO WEAR OUT.*
>
> *This level of personalization makes marketers salivate – but it will be a reality before we notice.*

This kind of collaboration can, at small scale, provide a great deal of convenience, and at large scale it can help us manage large, complex, "wicked" problems. But it can also violate our privacy, be used to spy on us, or simply provide an isolating bubble in which we know a lot of mass data but nothing about our specific situations.

To illustrate, Big Data connections could give you not only large amounts of raw data about the performance of 15-year-olds around the world in the PISA school assessments, but also intelligent analysis that explains why, in one country or situation, kids do better than in others. But you won't learn why YOUR 15-year-old is doing well or poorly from that information. You would need your own set of parameters, programmed just for you, to even begin to extract that information. That assumes that the algorithms are sufficiently sophisticated to be able to drill down and analyse a single case – something that is much more difficult to do than mass data analysis. It would also require a human to merge the emotional support your kid might need in a particular moment with the interpretation of unexpected data or occurrences that describes the particular needs of your child.

2.2 From Transliteracy to Global Competences for Industry 4.0

Transliteracy requires evolving beyond individual, linear human skills such as reading, writing, listening, speaking, or interacting. Complex hybrid communication demands intertextual abilities: from translation, correlation, or mental association, to analogy, context awareness, synthesis, or connotational association. Emotional skills such as empathy and engagement are also required to add enriched contextual interpretation to the matrix. Integrating and combining fragments of meaning from human and non-human sources into a holistic gestalt suggests levels of complexity that require new methods of analysis that must be applied in a collective context.

The elements of this kind of hybrid transmedia are likely to be more numerous and more fragmented than anything we know today, and involve many more codes, including machine generated deep learning processes. Deciphering and reassembling these fragments into a coherent story can be likened to a Wicked Problem, as formalized by Rittel and Weber (1973). That is to say, there is no "solution," but simply ways of approaching the complex interactions and understanding them in the moment needed, as they evolve.

Each analysis at any given moment is recursive, and we can analyze interactions at various levels of granularity. In Industry 4.0, the imperative is to produce real results and actions from this complexity. Software developers are already familiar with this way of thinking and working, which they know as Agile development (Agile Alliance, 2001). Agile involves frequent iterations of development, in which work develops in every area in parallel. Priorities can change at any moment, and definitions of quality or completeness are dependent on immediate contingent needs that also evolve.

Like agile development, hybrid transliteracy requires compound, intangible projective skills, which are strategically oriented. Problems are solved collectively, and social mediation skills such as negotiating, conciliating, or social media abilities are the added value that humans bring to the table.

Hybrid transmedia provides the framework for communication, and hybrid transliteracy is the skill for interaction in the Industry 4.0 informational ecosystem. To grapple with the high levels of complexity inherent in simultaneous, parallel multichannel communication, we need new, specialised analytical tools. Fractal models such as the nemetic system offer a transversal approach that helps us understand the fragmentation.

3 THE NEMETIC MODEL

3.1 Nemetics and hyper-connected Networks

Complexity, understood as a collection of elements and processes in dynamic relationships, can be better understood when seen as a series of recursive patterns that can be modeled. The system known as nemetics provides models that can help express co-creation in complex adaptive/creative environments, among humans and machines. Examples and methodologies have been developed by the International Nemetics Institute, using an organic definition flexible enough to adapt to any future evolution of hyper-communication (De, 2012).

The nemetic model provides quanta that help identify and analyze communicative routines. It includes dimensions of individual reflection, professional development, and organizational transformation. The analyses derived from it contribute to leadership and resource management, focus on integrated learning, and promote complex problem solving, as explained by Josefowicz, Gallon, and Lorenzo (2017): Nemetics functions as a fractal meta-language that facilitates communication among researchers in different disciplines to debate about complexity. The multilayer nemetics system provides a methodology for connectivist action-research and action-reflection in transmedia, including several meta-codes for visualizing procedures and results.

> *The essentials of Nemetics can be summarized in a simple mnemonic acrostic, which describes learning in any context at any level. At its most effective it is:*
>
> - *Notice without preconceptions (N).*
> - *Engage without judgment (E).*
> - *Mull before communicating or acting (M).*
> - *Exchange in the appropriate way and time (E)*
>
> *This basic path, (Notice. Engage. Mull. Exchange,) recalling the traditional Bloom taxonomy (Anderson et al. 2001), retrieves four action levels that may or may not be performed during interactions (after each verb, add the option, "or not").*
>
> *The whole conversation is then conceptualized as a single identified process, a NEME that can be seen as a coherent unit, represented visually by the interactions that took place during the debate. The analysis of these nemes shows patterns and waves of exchange that offer extremely rich information (big data) both about the media environment and the participants.*

In other words, the NEME is both a process and a communicative quantum – a unit of exchange than can be studied on its own. The recursive, self-similar nature of a NEME means that a NEME for communication between two agents can be contained inside a NEME for a network-wide communication, which can be inside a NEME for inter-networked communication, and so on. This fractal recursivity constructs a pattern that has been applied in The Knowledge Forum (Bereiter & Scardamalia, 2006), and has been identified as a path into high order thinking (HOT) processes (Rehage, 1994).

The simplicity of the nemetic process, which avoids hierarchies, makes it useful for developing agile models that can be generalized to help bridge the human-machine communication gap, and to design strategies for complex communication at all levels in the Internet of Things.

3.2 Nemetics and Artificial Intelligence

In this article, we have repeated that Artificial Intelligence (AI) is going to be driving many processes, and taking autonomous decisions that will affect us. If we humans want to maintain control over our own lives, and be good stewards of how AI interacts with us, we need ways to understand it that do not involve digging deep into digital code and trying to crack messages that are intrinsically unreadable to us. It will not serve for us to try and duplicate functions that AI will always do better than we can. Our role is to add value that only humans can provide.

Analyzing the NEMEs at different levels of granularity can help us do that. In the example we gave earlier about Big Data, using the PISA results, we referred to the difficulty of extrapolating reasons for the results of one single child from the great mass of accumulated data.

If we look at the NEME for the global results, and examine it iteratively as an agile software developer might do, we can begin to see patterns that emerge. We can see how the NEME for our country contributes to the global NEME. Our regional NEME, in turn, is part of, and also reflects, the country NEME. The local NEME carries characteristics of the region, and of the individuals in it, and finally, the NEME for your daughter or son relates to the local NEME, and their school's NEME. The school's NEME should provide enough information for you to understand the evolution of your child.

If we simply look at global or country results, we can't know anything about one child. If we only look at our child's performance and environment, we are unable to generalize even to our local neighbourhood. The recursive, fractal nemetic view of data allows us to monitor both, and by drilling down or up, make relationships, deduce trends, and understand consequences that take into account the unexpected, and allow for creative variance. These are the added value human elements that AI cannot provide. **REFERENCES**

Agile Alliance (2001), *Manifesto for Agile Software Development,* retrieved Jan. 29 2017 from http://agilemanifesto.org

Anderson, L.W., Krathwohl, D.R., Airasian, P.W., Cruikshank, K.A., Mayer, R.E., Pintrich, P.R., Raths, J., & Wittrock, M.C. (2001). *A Taxonomy for Learning, Teaching, and Assessing: A revision of Bloom's Taxonomy of Educational Objectives*. New York: Pearson, Allyn & Bacon.

Bereiter, C. & Scardamalia, M. (2006), Knowledge building: Theory, pedagogy, and technology. In: K. Sawyer (Ed.), *Cambridge Handbook of the Learning Sciences*. New York: Cambridge University Press.

Clark, R., Chopeta, L. (2004), Graphics for Learning: Proven Guidelines for Planning, Designing, and Evaluating Visuals in Training Materials. San Francisco: Jossey-Bass/Pfeiffer.

Costanza-Chock, S. (2014), *Out of the Shadows, Into the Streets! Transmedia Organizing and the Immigrant Rights Movement*. Cambridge: The MIT Press. Retrieved Sept 30, 20015 from: https://mitpress.mit.edu/sites/default/files/titles/free_download/9780262028202_Out_of_the_Shadows.pdf.

De, D. (2014), *Winning Anywhere - The Power of 'See': The N-E-M-E Way*. Partridge Publishing India, ISBN 978-1482818413.

De, D. (2012), Nemetics - Some questions and answers. In: *Leading productive and meaningful Lives* blog, interview by Rachel Pickett, Retrieved Sept 30, 20015 from http://dibyendu.tumblr.com/post/18006947480/nemetics-some-questions-and-answers.

Dena, C. (2009), *Transmedia Practice: Theorising the Practice of Expressing a Fictional World across Distinct Media and Environments*. University of Sydney. Retrieved Sept 30, 20015 from: http://dl.dropbox.com/u/30158/DENA_TransmediaPractice.pdf.

Duarte, G.A. (2014), Fractal Narrative - About the Relationship Between Geometries and Technology and Its Impact on Narrative Spaces. Bielefeld: Transcript-Verlag, Media Studies.

European Parliament Committee on Legal Affairs (2016), *Draft Report with recommendations to the Commission on Civil Law Rules on Robotics,* (PE582.443v01-00), retrieved Jan. 29 2017 from http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//NONSGML%2BCOMPARL%2BPE-582.443%2B01%2BDOC%2BPDF%2BV0//EN

Frazier, M. (2010), The early roots of the Nemes of Ebdish. In: *Storify documents*. Retrieved Sept 30, 20015 from: https://storify.com/ebdish/nemes-of-ebdish-p1 and What are Narrative Fractals. In: *Quore documents*. Retrieved Sept 30, 20015 from: http://www.quora.com/What-are-narrative-fractals.

Gallon, R. and McDonald, A. (2016), Content sensing and Information 4.0, in *TC World Magazine,* November 2016. Retrieved Jan. 29 2017 from: http://www.tcworld.info/e-magazine/content-strategies/article/content-sensing-and-information-40/

Jenkins, H. (2003), Transmedia Storytelling. In: *Technology Review,* January 2003. Retrieved Sept 30, 20015 from: http://www.technologyreview.com/news/401760/transmedia-storytelling/.

Jenkins (2007), Transmedia Storytelling 101. In: *Confessions of an Aca-Fan*. Blog. Retrieved Sept 30, 20015 from: http://henryjenkins.org/2007/03/transmedia_storytelling_101.html.

Josefowicz, M., Gallon, R., and Lorenzo, N. Transmedia and Transliteracy in Nemetical Analysis. In: *Encyclopedia of Information Science and Technology*, Fourth Edition. Hershey: IGI Gobal. Announced for publication in July, 2017.

Kinder, M. (1991). *Playing with Power in Movies, Television, and Video Games: From Muppet Babies to Teenage Mutant Ninja Turtles*. Berkeley and Los Angeles: University of California Press. ISBN 9780520075702.

McLuhan, M. (1964), *Understanding Media: The Extensions of Man, 1st Ed*. New York: McGraw Hill. reissued by MIT Press, 1994, with introduction by Lewis H. Lapham. reissued by Gingko Press, 2003. ISBN 1-58423-073-8.

Rehage, K. J. (1994). In: Anderson, L. W. & Sosniak, L. A. (eds.). *Bloom's taxonomy: A forty-year retrospective*. In series: *Yearbook of the National Society for the Study of Education* (Chicago: National Society for the Study of Education) 93 (2). ISSN 1744-7984.

Rittel, Horst W. J. & Webber, Melvin M. (1973). "Dilemmas in a General Theory of Planning" (PDF). *Policy Sciences*. **4**: 155–169. doi:10.1007/bf01405730. Retrieved 25 April 2013.

Steinberg, M. (2012), *Anime's Media Mix: Franchising Toys and Characters in Japan*. Minneapolis: University of Minnesota Press. ISBN- 978-0-8166-7549-4.

Thomas, S. (2005), Transliteracy – Reading in the Digital Age. In: *Higher Education Academy English Subject Centre Newsletter*, November 2005. Retrieved Sept 30, 20015 from: http://www.english.heacademy.ac.uk/explore/publications/newsletters/newsissue9/thomas.htm.

Wikipedia (2017), Industry 4.0. In: *Wikipedia,* edited 28 January 2017. Retrieved Jan. 30 2017 from: https://en.wikipedia.org/wiki/Industry_4.0