

Chrono-Spatial Intelligence in Global Systems Science and Social Media: Predictions for Proactive Political Decision Making

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Abstract. This paper discusses the advantage of social media in providing continuous non-linear, non-redundant information, taking advantage Global Systems Science (GSS) research tools and techniques. GSS matrix can indicate series of fortunate and unfortunate events that are not isolated but rather connected in time and space, sometimes appearing as events rising from serendipity. This proposition suggests that such hidden connections can be a new form of multiple intelligence named Chrono-Spatial Intelligence This is occurring by apparent or hidden connections between human or machine generated data and the time these occur so to investigate their connecting nodes, also linked to political decision making and learning. Although major prediction frameworks and systems exist as part of the GSS, it seems they cannot not successfully indicate or predict major or massive activities with global impact following the latest global events. Social media, semantic associations, local security camera data and other information have not been connected and analysed enough to predict undesirable events. Therefore, the main aim of this proposition is the identification, analysis and understanding connections between real-time political events for time-space investigation as Chrono-Spatial Intelligence. A second aim is to identify tools, methodologies and evaluation techniques to facilitate shedding light in Chrono-Spatial Intelligence understanding, analysis and impact related to political decision making, as for example quality in education. Future research suggests the proposition implementation.

Keywords: HCI · Chrono-Spatial Intelligence · Global Systems Science

1 Global Systems Science (GSS) and Serendipity

According to the EU, Global Systems Science (GSS) is to provide scientific evidence to support policy-making, public action and civic society to collectively engage in societal action (<https://ec.europa.eu/digital-agenda/en/global-systems-science>).

Crisis was a window to reality regarding the inability of the world states to deal with the global challenges such as wars, climate change, financial crises or energy sufficiency

to name a few without apparent and promising solutions depicted in the horizon. As the impact and effects of such problems are indeed global, and following the expansion of the locus of research the recent years, it is obvious that only global actions connected to local solutions may provide hope for change. In this proposition, the Internet as the global connecting network and an interdisciplinary ecosystem is the place to identify expanded areas for specific locus of research. It is also the exact paradigm of the ways citizens create their own space of communication and collaboration acting locally with potential for global impact. Identifying communication and interoperability between systems, connections and orchestrating actions with global impact may be the ultimate vision for GSS; in fact, any citizen can 'go viral' at any moment using the social media.

In this proposition, we utilise GSS systems thinking in connection to social media by integrating and linking data from different social media resources across diverse sectors and global actors. The challenges addressed here are related to policy design and political decision making on specific challenges, as for example, quality in education in order to incorporate and address the exact and future students' needs and responses connected to the global job market.

Politicians nowadays need to make decisions under uncertainty or conflicting evidence; also, as human beings and representors of specific political systems, they cannot follow disruption and uncertainty as expressed today. For this problem, the serendipity identification and advantage is proposed in this paper to fill in, according to Roland Burt University of Chicago sociologist, the structural holes and therefore, aid in proactive decision making. This is possible via mathematics and Big Data analysis, integration and visualisation, cascading and escalating effects in social networks and media, also taking advantage of indicator-based and event-based surveillance from cities and police cameras.

Other than following the events, social media are events creators and social reactors for even more ideas, social interactions and events to be created. Hence, informal learning creates great leaps of behavioural change. As such, causal collisions indicators in social media can build upon appearing randomness of events for predictions. Coming across ideas and event son social media can create the canvas for new ideas to appear and advance creativity to its most. This exact nature and characteristic of social media infuse more ideas and events flow as actions indicate ideas priorities in reality, producing events. Eventually, harnessing creativity and taking advantage of digital serendipity in social media costs much less as the cost of having barriers for collaboration and the cost of not knowing is rather higher.

2 Chrono-Spatial (Time-Space) Intelligence: An Introduction

Series of fortunate and unfortunate events are not isolated but rather connected in time and space and may be occurring by apparent or hidden connections. Although major prediction frameworks and systems exist as part of the Global Systems Science (GSS), it seems they cannot not indicate or predict major or massive activities with global impact. Social media such as Twitter, Facebook, semantic associations as with annotation homogeneity or other in correlations and associations with local security camera data

and other information such as local police data can provide hints or possible undesirable movements that have not taken advantage so far. Moreover, it appears that there is a need for optimization methods for training forecast algorithms, distributed forecast and knowledge management in the cloud as well as streaming media visualisation such as special purpose accelerators (H/W) for streaming media processing for knowledge extraction. As the World Wide Web and the Internet of Things offer the widest range of data in the human history, it is possible to identify the ways and impact that these are connected for predictions, aid or prevention for effective and efficient proactive actions long before events visibility occurs. The main aim of the project is the identification, analysis and understanding connections between real-time political events for time-space investigation as Chrono-Spatial Intelligence on individual level regarding leadership and European level. A second aim is to identify tools, methodologies and evaluation techniques to facilitate shedding light in Chrono-Spatial Intelligence Analytics understanding, analysis and impact.

Rapid capture of information of events and real time analysis and visualisation is a challenge we are attempting to address. The same GSS tools can create and group recommendations based on data analysis according to specific hierarchical categories. Discovering lines of actions behind appearance of events and unexpected actions processes can create specific motives and patterns to be identified, studied, analysed and understand under GSS analytics, so to transfer these patterns and structures in different fields and disciplines.

3 Chrono-Spatial Intelligence Research

Rapid technological changes influence communication, collaboration, information and knowledge management. Within the context of these new challenges, research design needs to explore human-human and human-computer interactions as lack of an agreed GSS research strategies at the moment leaves researchers planning without coherent frameworks. Also, the ethical principles for conducting research with human participants include general principles that may differ in e-research.

Chrono Spatial Intelligence Research contexts under investigation are based on global events, people, time and locations can generate visible pathways and connections via Chrono-Spatial Intelligence Analytics. These are: Chrono-Spatial Intelligence Analytics Design Methodologies as with Time series design; Chrono-Spatial Intelligence Analytics Methodologies, as with Quantitative and Qualitative mainstream methods, Specific Focus Groups and Interviews; data analysis via Sequential Analysis, Natural Language Processing and Social Network Analysis. Therefore, the proposition refers to the design and development of a new Chrono-Spatial Intelligence Platform for data visualisation, semantic annotations, analytics predictions Interface via forecasting algorithms.

The identified factors would be related to: (a) the context under investigation related to forecasting intentions identified in linear and non-linear actions; (b) timelines on past, present and future actions and activities as well as associations and links towards forecasting; (c) spatial intelligence referring to locations and links between time and space

events; (d) individuals and lists of individuals and groups as information and events hubs identified via social network analysis, natural language processing, focus groups and interviews; (e) contexts as with news channels, social networks with care on personal data and blogs feeds; and (f) identification of context conditions and dei-ex-machine. As such, the proposed research design is the time-series with time series real time streaming data visualisations (time) for predefined patterns and peak points identifications, abnormalities identification, and decision making identification points. The research methods are proposed to be the following: (a) Spatial Analysis (space – locations); Sequential Data Analysis (events - contexts); Social Network Analysis; and Natural Language Processing. The Data Analysis Outcomes are suggested to be identified based upon: Converged peaks from comparisons, Convergences, Divergences, People flow movement, Individuals identification, Valid Predictions and Forecast, Mistakes, Deus Ex Machina: non-apparent events / individuals working at the background and appearing the last crucial moment, as well as Insights from past to future; Insights from future to past and Forces and Initial Conditions identifications.

The practical implications are related to advanced types of machine learning for computer vision and text analysis by deep learning algorithms for certain tasks. Such deep learning models and systems for Global Systems Science can create learning nets provide the mathematical framework for an estimation problem analysis anchored in previous 8 case studies analysed backwards. This means start by major events and tracking them backwards to their initial conditions and origins appeared on the internet and social media in particular.

Chrono-Spatial Intelligence platform proposition can provide insights for diverse utilisation. Here, the advanced and proactive political decision making is targeted, based on the recent crisis event around the globe. Therefore, relationships between information, events, people, time, locations can be identified by Chrono-Spatial Intelligence Analytics.

Indicated Chrono-Spatial Intelligence Analytics Design Methodologies is real-Time series design with streaming data real-time visualisation.

Time-based coordination was used to capture the development and to triangulate sides of space and time of the unit of analysis. The use of quasi experimental time-short-series design was found a suitable approach to set a timeframe [7]. Time settings refer to two main sets, defining the baseline(s), and time series. Baseline refers to the observation of behaviour prior to any treatment designed to alter behaviour. As such, the treatment effect is demonstrated by a discontinuity in the pattern of pre-treatment and post-treatment responses. The groups which are going to be used in this study are inactive. The latter suggests a solid baseline for treatments and effects related to causal inference, not affected by threats like history, natural development and maturity for studies mostly observed in children's research. In time-short-series design aggregation and causal inference are not necessarily affected if a detailed amount of data could be collected. There are three dimensions to be investigated in order to examine the nature of intervention: (a) the form of the effect (the level, slope, variance and cyclicity); (b) its permanence (continuous or discontinuous) and (c) its immediacy (immediate or delayed).

Social Network Analysis (SNA) has been used to visualize communication and relationships between people and/or groups through diagrams by depicting social relationships between a set of actors [2]. The most widely used SNA attributes are nodes (the actors of study), relations (the strands between actors), and centrality (central or isolated person). SNA focuses on complete (or group) and ego networks; however, only group analysis on cohesion and centrality was found suitable for this study. In addition, several tools were considered for SNA as well as their integration in discussion forums as to support co-presence.

Cohesion: Network density for group thickness, reciprocity, cliques, and structural equivalence were used to measure the level of cohesion. Network density is the proportion of possible links in network that actually exist; it was evaluated by the adjacency connection reports. Sent-Received (S-R) number of messages is related to participants' reciprocity. More specifically, reciprocity is the number of ties that are involved in reciprocal relations relative to the total number of actual ties. A clique is a set of actors with each being connected to each other in smaller groups. Structural equivalence and in particular the CONCOR technique (CONvergence of iterated CORrelations [1]), describes the actors that have similar relations to others in the network with dendrograms. So the degree to which two nodes are structurally equivalent can be evaluated by measuring the degree to which their columns are identical:

Centrality: Group centrality [3] refers to the distribution of power between the community members and is measured by centrality, closeness and betweenness. In this study it referred to the total number of Sent-Received Messages (direct links), out-degree (replies made) and in-degree (received messages) centrality. Group closeness is defined by the normalised inverse sum of distances from the group to a node outside the group and related to reciprocal distances. Betweenness is the number of indirect links in which the actor is required as an intermediary; this characterise the mediator as the controller of the information flow in a network.

Knowledge of the ways and weight of ties between actors and events can indicate ways to strengthen collaboration and thus, engineering digital serendipity.

Social Network Analysis is a research methodology suggested for analysing interactions between humans. In GSS and in this paper, such connections need to also be related to Spatial Analysis of interactions between users and locations triangulated with other Big Data collection as for example police cameras and reports.

Time Series Design and Sequential Data Design and Analysis can shed light on the processes so to engineer serendipity in data not fixed in advance but incoming in a non-linear and agile format. The data is not stopped but continuous to be collected in time series and analytics, including usability analytics can be adjusted and also edited depending on the next incoming data. Comparisons and visualisations at earlier and later stages can provide insights for proactive decision making. Sequential Data Analysis (SDA) include transition matrix analysis, lag sequential analysis, frequency of cycles, graphical summarization techniques, and most importantly, pattern analysis techniques. Semantic Analysis such as Latent Semantic Analysis, optimization methods for training forecast algorithms and Natural Language Processing are also suggested as appropriate methodologies for quantitative and qualitative data analysis, however, not discussed in this paper.

Early identification for futile actions or beneficial ones can shed light for adjustment, enhancement or re-adjustment on proactive decision making. In some cases specific cycles and routines can be identified and utilised. Analysis and understanding of multiple matrices data provide the ecology for Chrono-Spatial Intelligence to arise.

4 Serendipity Engineering Economy with CSI

Serendipity Engineering builds upon randomness, interaction, chaos and complexity for innovative aspects and directions to be identified and taken advantage in favour of the user. In this way, serendipity and unintended outcomes can be manipulated to orchestrate pleasant surprises. According to [5]: *“Serendipity is the process through which we discover unknown unknowns. Understanding it as an emergent property of social networks, instead of sheer luck, enables us to treat it as a viable strategy for organizing people and sharing ideas, rather than writing it off as magic. And that, in turn, has potentially huge ramifications for everything from how we work to how we learn to where we live by leading to a shift away from efficiency—doing the same thing over and over, only a little bit better—toward novelty and discovery.”*

Accidental intentions can be engineered by directions and flow identification and moreover, enhance what is already there and moving [6]. Social media provide the mixed reality matrix with people, concepts, ideas and their relationships. Serendipity Economy is related to hidden value and potential in constantly shifting ecosystems that operate in rather apparent chaotic environments. Therefore, Serendipity Engineering Economy is related to return-on-investment on proactive decision making when taking advantage the social media for specific purposes, based on potential and anticipated outcomes from open, cross-organizational networking.

Social media research and CSI can built upon the structural holes for organisations, companies of even countries based on the following aspects:

- Predefined patterns and peak points identifications for both benefits and problems, so to apply restrictive or enhancing actions
- Abnormalities identification and study both the nature and characteristics as well as the impact on the context and the time series effects
- Decision making identification points and triangulation of chrono-spacial and human events earlier or later
- Converged peaks from comparisons and routines identifications
- Convergences and divergences on data visualisation as well as
- People flow movement can indicate both intentions and repeated activities in specific locations
- Individuals identification depending on specific criteria can also be more effective
- Deus Ex Machina for serendipity engineering reveals non-apparent evens / individuals working at the background, lastly
- Forces and initial conditions identifications to identify, restrict or enhance and recreate.

The financial benefits for providing such information towards proactive decision making can bring major advantages for the economy as the cost of resources would be minimised and directed to most effective situations and people support.

5 Concluding Remarks and Future Work

This paper described the advantage of utilising the power of social media utilising Global Systems Science (GSS) research tools and techniques. Fortunate and unfortunate series of events can reveal the matrix of creation for reality by revealing hidden connections in a new form of intelligence named digital Chrono-Spatial Intelligence (CSI). Digital CSI depends on the effectiveness for recognising apparent or hidden, serendipitous connections between human or machine generated data and the time. Such information can be the torch for proactive political decision making and learning bringing major benefits for the organisation that can adopt CSI in strategic thinking. Social media data in correlations with other data formats can provide information for real-time political impact related to political decision making, as for example quality in education.

Such GSS and machine learning also indicates scalable learning for us as humans and operators behind the machines. New tools can provide new lenses and extensions of our thinking processes; we are building the tools and then the tools impact us back in our perspectives. Social media is an emergent field and property for all to re-organise our strategies for collaboration and proactive decision making in an era of complexity and huge ramifications. In such chaotic environments, GSS can provide methods and tools for efficient actions with major impact for all in the direction we choose. Instead of repeating the same patterns and mistakes we can drive a different route towards serendipity for creativity and innovation with much lower financial and human cost and resources.

Among the 21st Century Skills [4] we consider to be the Chrono-Spatial Intelligence, also dynamic competence for a successful leader; bringing the right people to the right place at the right time for creating something new is indeed a combination of time, space and people intelligence. Nowadays, technology and social media in particular provide us with the methods, approaches and tools to discover the connected links between people and events and be responsive about the consequences. Future research suggests optimization methods for training forecast algorithms and streaming media visualisation as well as our proposal implementation.

Chance favours the connected mind.

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