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Change analytics
Needs & Participatory Challenges for Change Aiding

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Summary

This position paper elaborates on the need to focus some developments of Policy Analytics on "significant change" processes, like regime transitions, structural transformations and social movements. It proposes to structure a stream of "Change Analytics" and to develop the related solutions as a Change Companion platform. It tackles both the institutionally driven processes and the bottom-up citizens' initiatives. We consider the specific categories of Analytics solutions relevant for Change. We elaborate on the dual relation between Change Analytics and multi-level participation, co-feeding their development. We question the categories and assumptions of Analytics when dealing with "significant change" and especially the features of analytics which could stay valid through transitions. We argue on the need for controlled social experiments, in laboratory, in the field or as real-life policy experiments, opening to integration between intervention research and change analytics. Finally we propose steps in a research protocol and directions for a Change Analytics infrastructure.

Changing Analytics to refocus on Change

Change[1] is a major challenge for public policy analysis, design and implementation. In terms of fairness, feasibility, efficiency, sustainability, it tackles the capacity of the society as a whole,

[1] As « Social Change » vs. any kind of change which doesn't require behavioral transformation or doesn't impact on human well-being: "Change" addresses some significant transformation of practices, not "usual", not customary, not straightforward, perturbing habits, norms, social relationships, and with significant consequences in terms of well-being, personal resource use, beliefs and / or social position. E.g. buying a new car to replace an old one is not a relevant change, unless a trade-off exist between getting a new electric car

individuals and institutions, to acknowledge its actual situation, to formulate clear and equitable targeted transformations, to share and assess possible pathways, and to "action" them in a democratic way. On the political side, the prevalence of "acceptocracy" (when meta-policies chase ways to get citizens to *accept* some change decided "above") reflects either a loose alignment with the real needs and expectations of the citizens, or an argument of efficiency and performance of the technocratic system supported by urgency, or simply a regime of power and assets conservation for some, when structural change targets first the most deprived (via unstable "flexible" jobs, migrations, reduced entitlements to common or natural resources). Meanwhile in society, change mottos or imperatives are pervasive in the environment and the media: about climate, food, education, fashion, lifestyle, mobility, cities and landscape, social ties and groups, gender, technologies, and even truth itself. And change is often driven by consumption and growth patterns (buy, use, or produce, something *else*). Hence change pressure is ubiquitous but ambiguous, and citizens can soundly question the vested interest behind such trends, legitimizing their own resistance. Companying citizens toward an autonomous, enlightened, but also truly sustainable and equitable (i.e. systemically aware of limits), self-engagement in change vs. conservation could be a reasonable program for redefining conditions of better governance. But the factual, intellectual, procedural, political and material grounds and instruments are not obvious.

In such context, and considering the necessary arbitration of the distribution of the scientific support to methodological developments, we argue for directing part of the "policy analytics" program toward what we call specifically "***change analytics***", and we want to discuss here its essence and consequences. We'll especially argue that when autonomous and enlightened change is at stake in multi-level governance, the research and experimentation aims should be reframed. Without reducing the value of the Policy Analytics program and tools, we propose not only to build some specific "*analytics of and for change*", but also to "*change the analytics*", even at this infancy stage. Namely, if we'd follow a natural flow based on Business Analytics with expansion to value-driven policy support and the features exposed by (Tsoukias & al, 20013) and (Daniell &al, 2015), the focus risks to stay on a classical command-and-control paradigm using the existing big-sets-of-data to provide evidences to improve some general top-down policies for change. Conversely we argue for some alternative principles essentially addressing a procedural primacy, the purely instrumental role of data (*i.e. that data existence does not steer the question addressed)* and above all the fundamental role and requirements of multi-level participation. The program of Policy Analytics is preserved, but refocused and reorganized in its sequence.

How Change tackles data and information based analytics

Although it's clear that the endorsed heritage of Business Analytics builds on strategic decision aid and operational management –which also have a change dimension-, our focus on aiding Change, as projected social change or "autonomous change", raises many issues among which: social choice controversies, non cooperative actors and distributive processes, cross-sectoral competition and conflicts, non economic rationales, principal-agent problems, all classical innovation barriers and resistance to change, power distribution vs. locus of change, fairness and equity of change, role of

(expensive) and maintaining another leisure activity – Resigning from watering garden within a green-lawn neighborhood – Joining the dance - Welcoming a migrant in a spare room at home – Working part-time as a personal choice – Becoming vegan – Declaring all incomes and pay related taxes – Believing and adopting a religion – Reducing an addiction - etc. Reference cases considered in this paper are mainly in the field of socio-environmental management.

deliberation, political grammars for change induction, role of civil society and meso-scale unformal organizations, role of "historical actors" or leaders, education and self-education, adaptive strategies…

To navigate such a variety of rich and challenging questions, and considering the Change paradigms, let's address two main categories: the Change processes which are intentionally designed ("let us change" or "let them change", whether there is an external principal or not) vs. the unformal loosely structured emerging dynamics in social groups (where the role of the Analytics is more questionable). In the first case, there is a program and an active mobilization of instruments; in the second, some instruments can be used on the way but without a deliberate mandate at the beginning.

For the first category, a canonical and procedural change process can be phased in line with some standard policy stages:

Warning / Awareness / Discovery → Situation Assessment & Preparation → Change' Aims Assessment → Options' Design and Assessment → Option selection → Commitment → Implementation → Evaluation → Adaptation / Revision

This very normative and structured model can be activated only partly and adapted pragmatically but the steps cover the spectrum of needs which may appear. In such context can we assess which categories of data and information could be useful? The Table 1 gives an insight on the challenges and the related data or information needs for each.

There is no claim of overall coherence or universal validity for this inventory. It aims at showing some diversity of issues and challenges for Change Analytics. It generally should demonstrate how much the existing data, algorithms, protocols or even institutions may appear irrelevant or limited. Several research streams may emerge here. However, and we'll come back to this question, only the stakeholders themselves could –on the base of an adequate pre-training- reveal and structure their actual needs. Meanwhile the best expertise, interdisciplinary compendium and collaboration, sources of valuable behavioral data, must be associated toward an actionable research and development community on change.

Phase	Role of data or information	Challenges	Analytics' needs and missing data
Warning / Awareness / Discovery	Awareness / elicitation on the change drivers and signals: stress (social or environmental), threat, crisis, boundaries, social movement, personal tension, boredom, personal options, others' life, dreams, heaven, others' change history, mood for change	"time to change": in information overload, select relevant signals and evidences for a given attention or preference pattern – reveal and structure the related boundaries or attention model for individuals and groups – reconnect individual behavioural patterns with their consequences and constraints (e.g. resource exhaustion or tragedy of the commons) – reveal other change trajectories as "reference cases" – identify social clusters and similarities in change expectations benefiting from mutualisation (e.g WeightWatchers™) -	→ Collecting and structuring systematic data about behavioural change in their context: volunteer recording vs. change tracking based on status observation (+ privacy issues) → Classify and share the related change patterns → Help users eliciting their change preferences →Help groups eliciting their collective boundaries → Connect behavioural models with resources dynamic models (data based) and boundaries to throw alerts → Set ethics of change awareness Analytics
Situation Assessment & preparation	Refinement of previous change triggers or warnings to assess the detailed situation and qualify urgency – Then decide and prepare a change process by engaging stakeholders and means	Gather and structure relevant data, knowledge, models to get evidences for assessing urgency and scope of the change – Assess alternatives if no change - Identify other stakeholders or sectors embedded – Qualify constraints and potential resisting factors - Assess means – Support deliberation – Design and agree on a change procedure - Formalize - Commit	→ Analyse past change trajectories to get meta-models for scope, factors, processes, actors → Structure existing qualitative knowledge on change processes (e.g. social sciences) to make it actionable → Set and manage stakeholders' registers → Support situation modelling (participatory) → Support argumentation on change processes using principles of this Change Analytics framework → Model and aid decision on change processes with procedural tracking and dedicated workflow → Manage commitments and participation
Change' Aims Assessment	Structuring, prioritizing, selecting aims: changing what, why, when, in regards to expectations?	Help eliciting actors' preferences or expectations referring to current situation - Sharing the assessed situation, help persons, groups, institutions reflecting and specifying their actual aims – Reconcile individual aims in collective or systemic dependencies – Tackle and refine "change to change" profiles - Help eliciting origin of the change intention (autonomy) – Support deliberation – Share aims to induce social support	→ Collect and share Change' aims databases with context → Help self-behavioral-modeling to infer aims (indirect elicitation) → Critical / reflexive review of change' aims → e-Deliberation about change' aims → Free statements of aims and progress

		and motivation	
Options' Design and Assessment	Considering possible change' actions or strategies, adapting some and assessing the conditions, uncertainties, effects	Identify options for given situations and change' aims – Collect direct and indirect causes in past cases – Assess actual requirements, conditions, cost, and various impacts of options – Assess options' dependencies, especially between individuals and institutions - Infer transferable knowledge with actualization conditions – For social / collective options, structure pre-negotiation and assess options' social feasibility – Qualify and compare uncertainties – Structure options' comparison under the actors' specific decision model – In complex situations, simulate combined options sets from sub-groups to assess non linear and contingent effects, including social constraints (normativity)- Support consensus on options' pre-selection – Enrich and extend options' sets to tackle cognitive and normative framing	→ Change' options databases, with computable case description, and all data on conditions and uncertainties, including social → Causal analysis and efficiency of past intentions → Disentangle the specific from the path dependency or procedural factors for options' impact → Model and generalize options' use as a set of actionable guidelines → Format procedures (workflow) for options' collective assessment and consensus building (on alternatives) → Filter options' generic references through actors' Change frame and render it for sound comparison → Protocols and tools to model and simulate heterogeneous change strategies in complex systems → Engage stakeholders in simulations and deliberations → "Push" / recommend options under ethical rules
Option selection	Among the considered Change' options or strategies, choose one	Multi-stakeholders / objectives / criteria / level options' ranking – Deliberation and argumentation for ranking – Arbitrating dissensus for social dilemmas	→ Classical MCDA → Convergent argumentative systems → Managing "split" strategies
Commitment	Formalize and share the chosen option	Support representatives in transfer to their constituencies or interested groups – Feedback rationales, argumentations, causes – Structure and record commitments or contracts, if any – Publish to inform external stakeholders	→ Record and render previous deliberations → Structure and render synthesis of causes → Format and secure commitments, with access → Connect to all relevant external stakeholders
Implementation	Support the actual change process, implementing the chosen option	Implement specific data or information production, or analytics, if chosen as change – Provide required information or infrastructure to help piloting the change process – Provide training and guidelines	→ Rapid adaptation and design of new Analytics chosen → Extract specific information and support from past Change records → Co-pilot implementation of change → Change' training
Evaluation	Monitor and evaluate the ongoing change process	Dialogue and design the monitoring program – Engage and support specific participants - Set monitoring program for the specific change activities	→ Monitoring and evaluation protocols' databases → Stakeholders analysis for monitoring and evaluation → Aiding decision on monitoring and evaluation

		– Record multiple impacts inside and outside the targeted process – Detect weak and early signals in case of unexpected consequences (as emergent risks) – Evaluate "distance" from target change – Publish	→ Install required sensors, probes, observers, surveys → Design ethics for the monitoring process → Structure and collect data on multiple change dimensions (inside / outside): environmental, technical, economic, institutional, cognitive, normative, relational, practices → Filter observations and match with predefined boundaries (viability constraints), even outside the core target system → Measure or assess complex multi-dimensional distance from aims
Adaptation / Revision	"Change the change": assess progress toward aims or path and consider adaptations	Process evaluation results to decide when adaptation or revision of the change' strategy is required, according to meta-rules – Establish these meta-rules – Decide level of revision among the change steps (reassess situation vs. change aims vs. change strategy) - Set deliberation to discuss balance between continuation and revision	→ Trajectories and categories of meta-rules for adaptation → Classify possible alerts and prepare for them → Compute cost-benefit of continuation vs. revision → Engineering and automatic support of adaptation → Specific deliberation on second-order adaptation

Table 1 : change steps and the related information challenges

Regarding the second category of change processes, the unformal and emerging change dynamics within groups, there is by definition no specific procedure (although the sociology of social transformation explores the recurrent and structural patterns of initiation, development and extension of Change processes in communities). Hence the specification of the related Change Analytics requirements is more contingent and would require some dedicated cases' analysis, or *ad hoc* co-design with these same groups.

However most categories listed in Table 1 may still apply at some stage of the process, but with an opportunistic activation: make accessible for stakeholders early signals or warnings about change, which would lead someone or a micro-group to consider changing, etc. But for unformal processes we may observe processes where there is neither a clear intention to change nor a structured and linear sequence. For Change Analytics in a perspective of autonomous change, the challenge is different: providing support through open and versatile access to targeted solutions answering specific questions relevant for the agents, responding to their willingness. Such issues may include: do I need to change, what, with whom, which constraints would I face, which pathway can I follow, how to access the means, how to support my own ongoing change, how to share it, etc. In terms of Change Analytics, we may consider offering a personal dashboard, customizable and potentially connected to value some external personal data, where anyone could set and use a dedicated workflow –or "changeflow"-. As such change process expands usually as a group dynamic, it requires specific collaborative tools, to align individual change agenda, to mutualize aims and means, and to build synergies and mutual support. From the perspective of public institutions, it could be beneficial to establish such generic service, even without orienting it toward a given policy, as it could contribute to add on social agility, adaptiveness and responsiveness toward policy incentives, notwithstanding the creativity and development effects in society. Again, citizen based (participatory) and experimental co-design of this platform itself is probably the best strategy, with a strengthened role of the civil society groups.

Participatory Design and Piloting of Change Analytics

Under a multi-level integral participatory paradigm, all stakeholders, including the lay people themselves, may play a role in the policy design and implementation. This is commonly justified by arguments of local relevance, intrinsic legitimacy, endogenous social normativity and trust renewal, notwithstanding legal evolutions for the democratic systems. Meanwhile, the notion itself of participatory policy design and implementation can be criticized as crystallizing the normal top-down vision of change. Change occurs constantly at all social levels, and as evocated we have to consider support we can provide for autonomous-and-enlightened local or meso-scale change, led by individuals or groups; but to improve equity, feasibility and sustainability of these changes the questions of frontier of relevance and systemic impact assessment are to be addressed. In other words, following a management science or decision-aiding perspective, who is our actual "client"? By our provision of "change analytics instruments" can we support a small group of stakeholders following their own agenda, with reduced consideration of the side-effects and potential delayed negative feedbacks ; or from a "(public) policy analytics" perspective, should we always help "them" to reconsider the position and impact of their change in regards to the surrounding social and natural environment? The underlined grammars of social transformation oppose a liberal distributed vision with a regulated and harmonized meta-policy. Four models emerge: one institutional standard where participation is driven by-the-top (which is already a progress in regards to non participatory processes), one distributed but not integrated benefiting from the "free" change initiatives, one

more integrated where these local autonomous change processes are assisted to better account for their environment and side consequences (which questions however the ethics of this overall framing), and finally a multi-level integrated model where autonomous initiatives are led to dialogue with the institutional policy making and "co-change" is fostered toward better equity and sustainability shared among sub-processes. Which Change Analytics is required to aid these four models?

To answer this we propose to build conditions for a participatory design of the Change Analytics program itself. It means essentially engineering conditions by which the various stakeholders embedded in each change process, intentionally or not (i.e. including the impacted citizens), would be able to assess their change conditions (drivers, constraints), to relate this to information or knowledge provision, and to select an Analytics strategy based on its cost and expected benefit. By "Analytics strategy" we mean the sequence of information selection, capture, processing, rendering, dissemination, using the most relevant methods for the given aim. Can we design it through real participation, considering the complexity and expertise required for mastering Policy Analytics? As for other participatory processes, it combines two aims: improving the quality and relevance of the result, here the Change Analytics strategy (N.B. the "result" is not the outcome of the strategy but the strategy itself), and getting participants to integrate the results in their future choices and actions, namely to adopt Change Analytics as a valuable and socially normal instrument. For the four models above, there are differences in the participatory design process in terms of independence given to the individual or meso scale initiative vs. the institutional policy and the overall context of change. This leads to associate different stakeholders in the participatory design and to activate different "modules" of Change Analytics. But a common framework can be developed, in line with the first part of this analysis. In a first stage, and for sake of efficiency, specific application domains can be selected, for instance mobility, water consumption, or personal health and food. Later, harmonization and generalization may lead to a unified platform.

In practice, we need to structure, initiate and implement a specific participatory process aiming at designing and piloting the future Change Analytics programs. Five main stakeholders groups must be considered: the Change Analytics "experts" and solutions developers, the public policy representatives, the private business and economic sector, the intermediary stakeholders from the civil society groups and the citizens themselves. To avoid falling in a classical "technological push" approach, specific participatory design instruments may be favoured: participatory design, participatory simulation with mock-up service, usability crash test or even citizen juries (which applied to the question of "how can we change", and internationalized, may be a definitive breakthrough). In a second stage, the participatory structure may be kept active to pilot and adapt the ongoing developments, or respond to new emerging needs.

The role of private companies, technology and service providers is dual: providing and informing on possible options for Change, as components of the decision sphere, and providing specific algorithms, databases and service to contribute to the Change Analytics infrastructure. A reasonable balance between the business models of the partners and the overall public good orientation has to be defined. A typical future approach could be to use the platform as an information base advertising equally various "business based" solutions, and letting the stakeholders select and include some of them. For the Decision Aiding service, they must be funded and included in the general business model of the platform, whereas it follows a pure public or a hybrid private-public model.

Such general approach of multi-level participatory co-design is by itself a preliminary challenge for the future extension and success of Change Analytics. It would also benefit from the experimental strategy developed further down.

Change Process Analytics

Change is obviously a dynamic process, a sequence of states, actions, decision, more or less intentional, and responding to its environment. But "significant changes[1]" are regime shift, mode transitions, behavioural reorientation, social reorganizations, which structurally affect the conditions of evolution and interaction, and impact even on the decision and action conditions for stakeholders. It's an essential task of most sciences, but also journalism, to observe, qualify and eventually explain them, trying to distinguish and explain the first and second sort. However most data collection processes, whereas by biophysical sensors or recording of human activities (material or digital), catch snapshots of current states, generally in steady regimes. They are rarely designed to capture the transition phases, as "change sensors"[2]. It's only secondary inference, by data processing and other Analytics, which can assert that a transition may have occurred. Furthermore it's after a sufficient delay that it can be verified, when a new steady regime or standard behaviour or norm has been established. Short term fluctuations may lead to "false positive".

When a "significant change"[1] took place, the infrastructure of action itself, its material components, its spheres of development and impact, would have also changed, and the previous data collection strategy becomes deprecated: for instance if someone decides to switch forever from individual car mobility to using public transports, although any internal car sensor would show it's nowadays static, it cannot produce any new data on the past driver, who became a bus passenger – and conversely new buses' users cannot be tracked back in their adoption based on car-based data. And if the car is sold it can even produce wrong interpretations by confusing owners. Hence there is an issue of "robustness to change" or "accuracy range" of the Change Analytics: how much a given set of data, processing, rendering is still valid after some "significant change". Designing such robust Analytics is required to produce knowledge on the change processes, assess the conditions and the stability of the transition. A reasonable assumption is that the related Analytics apparatus should be always more generalized than the category of process it aims at tracking or supporting: addressing mobility change requires the Analytics' sources to be independent from the mobility mode itself.

Similarly, although the tracking and interpretation of the "reasons of change" has been the mandate of several domains like economics, psychology, marketing, sociology, political sciences, they ground much of the results on a processing and analysis of time series of instantaneous data or observations, with their context, and they try to decipher what actually triggered the transition – often with contradicting assumptions. Change Analytics may benefit from a more systematic a priori design of Analytics strategy which would directly target the transition phases, aiming at capturing more explicitly their initiators and rationales. That would require collecting explicit statements of willingness to change from actors and setting an Analytics around their situation. It may also benefit from a direct companioning of the Change processes (individual or collective) with dedicated procedural workflows: supporting the change steps is an obvious way to produce knowledge on

[2] The speed or trajectory of a car are dynamic information, capturing a changing state, as well as the sequence of buying of a consumer, but it is not the kind of change addressed here, unless for instance the car would suddenly and for long leave its usual region, or the consumer would definitely abandon all forms of meat. The latter would indicate a new diet – or a new provider not surveyed.

these same processes, whereas a platform only requiring users to declare their intention, thoughts, doubts, influence, without any "pay-back" service, would be more prone to failure.

Finally, as for the explicit monitoring and evaluation programs devoted to public policy processes, managing in a Change Analytics apparatus to monitor most of the "possible rationales" for change in a given case study environment would certainly strengthen further analysis of the drivers and improve the induced support. Ideally a wide set of features should be monitored *a priori* in regards to a given population, expecting some "significant change" to happen for at least some and tracking back their causes. The cost and complexity of such observatory program would be generally very high; and some key features, like for instance the evolving social relationships and structure, or the occurrence of given events in the personal life, are out of reach of any reasonable platform – at least for ethical reasons. The aggregation and processing of existing behavioural data (from the current bases) may give insights but not detect the main drivers. So, again, the perspective may be changed by resetting the Change Analytics priority not on an observatory of change processes and drivers, but rather on a smart and attractive Change Companion which would balance its data greediness by a real help offered to a person or community. The limit of this approach is that when a client would require a Change Companion s/he would probably have already progressed quite much on the way o change (considering already the issue of change), and it may be "too late" in terms of transition analytics. Trade-off related to the means and the urgency of change must be considered to decide between an extensive Change Observatory and an *on demand* self-monitoring served by an Analytics companion.

These three perspectives share a common focus on the Change process and procedure, for which specific Analytics could be proposed if the relevant social protocols and technical infrastructures are available. A minimal requirement to feed such research and development would be for all public policy programs aiming explicitly at change to dedicate a reasonable and normalized share of their budget and stakeholders' commitment to monitor the multi-dimensional conditions, the detailed experience of change by actors and the outcomes. Normalizing a Change Analytics procedure for such policies may deliver a wider social value, and would nurture all future forms of Change Aiding. More generally, the challenge of Change should help reframing some of the public information systems, data collection and the related methodological innovation from the current status indicators, for steady regime and achievement focus, toward a transition and pathway focus, with unstable and singular events, fine tracking of drivers and agency-based design (perception / decision / action).

From experiments to action research for Change Analytics

Controlled social experiments for small groups, either abstract and parsimonious like in Experimental Economics (or Field Experiments with real stakeholders), or more realistic and externally valid when based on contextualized role playing games, provide an efficient investigation instrument about change. They allow direct and explicit control of the possible drivers, facilitate recording of the transition steps and, for the experiments including social interactions (dialogue, influence, co-regulation), may explore complex social factors and dynamics. For assessing multi-level processes associating citizens' change and institutional change, two-level experiments can be set, combining local community change interacting with policy exercises or simulations mimicking the adaptive policy process, in a vertical dialogue. These experiments provide a necessary ground for any Change

Analytics based on social modelling and simulations, even when using large data sets (which, again, very rarely capture the transition dynamics and rationales).

Their validity for exploring "significant changes" or transitions (which are structural, long term and socially supported) can be limited by the short time scope and the virtual participants' engagement, even when monetary pay-off are used. But they can structure useful secondary dialogue among participants, and trigger more enlightened deliberations. Hence, for Change Analytics, such experiments can play a double role:

1. *Testing*: when participants are equipped with candidate, simulated, Change Analytics instruments (e.g. device, information, procedures), they would combine reaction to them with social dynamics, and would provide useful evaluative base for improving the design, or rejecting them as inefficient. External validity could be pursued later by developing real life experiments through action research (see below).

2. *Exploring change*: knowing their limits for "significant changes", they however provide an accessible and controllable benchmark about change dynamics, with lower cost than large scale and protracted observatories.

At the fringe of standard experiments, policy designers can even consider assessing the relative willingness to pay, or similar preference statements, for Change Analytics informational and decision support, in contrast for instance to direct economic incentives (information support vs. payment).

To overcome the limitations of these controlled short-range experiments, larger scale and real life Change Analytics experiments can be settled. In this case, under pre-specified assumptions, a prototype Change Analytics apparatus is set and proposed for real stakeholders, with an adequate monitoring and evaluation. Various groups in similar settings can be equipped with different service versions, or no service (control), to obtain comparison. When the Change Analytics scientists stay in the process and contribute dynamically to data processing or adaptation, it enters in the Intervention Research category with its specific constraints and ethics. Generalization is of course questionable as this role played by the experts is potentially irreproducible, as costly and highly contingent. At one later stage, independent Change experiments should be set without any intervention, and transfer of all experts inputs in the Change Analytics apparatus itself. The challenge is major as the experts' input is not only knowledge based, but deliberative, interactive and constructive (e.g. providing on the way new forms of support after some structural transition has happened – cf. above the limited validity of data systems for "significant changes"). A real space for serious artificial intelligence exists here. The overall sequence of small scale experiment, followed firstly by intervention research embedding the researchers (supervised Change Analytics), followed secondly by autonomous real life experiments (and "intelligent" Change Analytics), opens a long term program to be transcribed for the various themes and contexts.

To feed this line of research, in a recent workshop[3], scholars and practitioners have exchanged on the relation between Policy Analytics (not strictly Change Analytics) and Intervention Research (which leads to a transformative focus anyway), on the base of different cases. It has questioned the

[3] « Policy Analytics & Action Research », Australian National University, Canberra, AU, 17/4/2018, K. Daniell, N. Ferrand, org.

processes, the data and information used, the actors' roles and the impact of information. Specific questions and statements by participants included for instance:

- Which questions raises Intervention Research toward Policy Analytics? Should the Policy Analytics be adapted during the Intervention Research process, based on a meta-strategy, or should it stay stable for sake of longitudinal evaluation?
    - *It tackles the impact of the intervention itself, and would require finer process monitoring to extract the inputs and effects of the researchers' interventions - Via the intervention, it switches the paradigm of Analytics from observation to experiment. For Change Analytics, researchers should be the ideal providers of a change monitoring system, as they have mandate to produce such knowledge - It opens ways for comparative testing of the impact of intervention on change – It questions the aims and focus of the researchers vs the stakeholders, and requires clarification - Can micro-level participation be supported? Can unstable policy contexts or governments be addressed? Can we automatize the Analytics? Which ethics of Analytics for intervention?*
- How should we adapt Intervention Research to benefit from Policy Analytics? When and how to mobilize the Analytics? What can be the expected impact? Should we adapt the standard process monitoring and evaluation?
    - *Develop specific ethics with strengthened data collection – Include Analytics in the procedural design, as a step or tool – Reshape Monitoring and Evaluation to combine with the Analytics - Foster Analytics' integration as a tool for adaptive management – Use the Analytics to improve stakeholders' analysis and management – Can some participants become analysts? - Can Policy analytics help making participants more responsible or accountable? – Can the processes be standardized to be comparable?*
- Which experiments can we set in Intervention Research to improve Policy Analytics?
- Is Policy Analytics still valuable when not interfering in or with the ongoing intervention research process? *How to include the Analytics feedbacks in a pre-defined process?*
- How can the development of "actionable knowledge" be facilitated through co-design and use of policy analytics in Intervention Research processes?

For Change Analytics, most of these issues stay valid. The relation between Change Analytics and Action or Intervention Research is a twofold design challenge, knowing that it can benefit both: on one side, Intervention Research programs require better monitoring and evaluation with the Analytics and clearer protocols for information feedback and adaptive steering (e.g. should the Analytics "perturbate" the process?); on the other side, Change Analytics need large scale controlled experiments about Change dynamics, to improve its foundations and usability for the general cases. Ethical and epistemological issues are major and pending for the research community.

Perspectives and proposal

This overview calls for a specific stream of research and development, which, as argued in the last part, should be based on various forms of controlled experiments and intervention research. The validity, appropriation and impact of the future Change Analytics apparatus can be improved by a strong emphasis on multi-level participation as a mean and as a target. In this conclusive part we propose firstly a set of key challenges, opening to a development program, and secondly a tentative service architecture for a Change Companion infrastructure. As we'll comment later there is a slight

contradiction in the participatory design principle and this same proposal appearing already mature, but reflexive solutions are considered.

Challenges and Development Steps for Change Analytics

- Program structuring
  - Identifying and engaging scientific and operational partners, with application cases
  - Setting and funding the support projects
- Conceptual and analytical foundations
  - Boundary definition of "significant changes" for individuals and organizations, as regime shift or structural transformation vs. "casual change", out of scope.
  - Inventory and classification of Change configurations, case-based
  - Multi-disciplinary state of the art on change dynamics, triggers and support
  - Modelling change dynamics as a base for further aid system
  - Existing procedures, methods, strategies targeting change
  - Review of the Analytics instruments targeting significant change
- Evaluation and ethical framework
  - Defining goals and conditions of the preferred Change Analytics
  - Identifying measurable indicators related to use and impact
  - Defining ethical rules for the whole information life cycle, including privacy, transparency of guidance, informed consent, participation
  - Setting monitoring and evaluation system
- Participatory design
  - On a case study base, identify and select an initial Pilot Group and other stakeholders groups
  - Participatory needs assessment using scenario analysis, evocation of options and focus groups with various stakeholders
  - Social experiments to test and compare various Analytics options
  - Participatory co-design of a change governance process including Change Analytics (with PreParticipation methods)
- Methodological design and development
  - Based on needs and the state of the art, propose a set of aiding protocols and specify the related information collection, processing, rendering services
  - Contact and negotiate with classical Analytics data providers to adapt their service
  - Develop and verify the services, aggregating existing standards (see below)
  - Test the services through unitary experiments with real users
- Participatory experiment
  - Set and start controlled in-lab experiments, abstract, or role-playing – process and feedback
  - Set and start field experiments – process and feedback
  - Set and start larger scale intervention research processes
  - Open capacity for autonomous experiments for local & emergent change processes
- Dissemination
  - Structure and publish documentation
  - Structure a dissemination network with civil society organizations and administrations

- Training

The two essential elements are the change produced on the classical Analytics in terms of research and data provision, with a focus on transition processes and procedure, and the use of multi-level participation and experiments for design, test and extension.

"Change Companion" infrastructure

The "Change Companion" infrastructure is a dedicated Analytics platform to aid multiple stakeholders in their phases of change for public affairs. We address here three main categories of users or partners: institutional process managers, citizens and other participants, scientists or experts. The target needs and the related services are addressed in Table 1. We focus on the institutionally driven processes, knowing that the autonomous change category can also mobilize opportunistically some components.

This infrastructure should have 4 essential poles:

- **Change knowledge exploration**: knowledge base and knowledge valuing about past change processes;
- **Change monitoring and analysis, signalling and diagnosis**: long-term and wide range background socio-environmental monitoring (with external service connexions) to observe and detect situations and distance from stakeholders' chosen boundaries or thresholds; monitoring ongoing change processes with transition-robust tracking; selective and profiled information and warnings to users; support for improved diagnosis of situation and change requirements;
- **Change process design and stakeholders management:** pre-participation tool for self-selection of participants and scope, decide aims and indicators, choose steps and methods, set ethics.
- **Change participatory workflow**, including policy experiments conduct, procedural governance and individual support for change: main operational "companion" implementing the selected change process, as a support workflow for participants, managing institutions and experts, under the given ethical rules; informs step after step on actions; gives access to knowledge and guidelines; facilitate interaction and collaboration; advises users; records results. Looped with the change monitoring to evaluate ongoing change.

The modules' technical options will be detailed elsewhere, but they can mobilize various Analytics' technologies, in terms of procedural data analysis, profiling, learning-to-advise, infographics, distributed processing, multi-sensors & hybrid integration, community platform, argumentative mining and support, hybrid and participatory modelling and simulation. Iterative agile design and development, with test case studies, should obviously be the approach for future extension.

Conditions for an initial participatory co-design

The methodological proposal for an initial co-design of a Change Analytics program could be as follows:

1. Identification and selection of representative stakeholders from the 4 categories: researchers and specialists, public institutions, civil society organizations, business solutions providers.

2. Gathering expectations, constraints and references, based on a common survey. → On this base prepare a reference use scenario covering the main issues (see below).

3. During a one day session of:

- Joint conceptual mapping of the Change challenges, coupling needs and solutions in the form of speed-dating *ala World Café.*
- On the base of an initial (prepared) use scenario (simulating a future user), played step after step, collect reactions and proposal of participants
- Assess the categories Analytics existing and to be created
- Structure an overall plan

4. Structure and set an overall development program with the partners.

5. Session evaluation