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Using affordance analysis to design individual analytics ecosystems

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Maedeh Yassaee, Tobias Mettler, Robert Winter

Organisations in Asia and worldwide are actively looking for ways to take advantage of big-data analytics. Big-data analytics is, however, mostly applied to well-known use cases in financial analysis and profiling [1]. A high rate of work-related accidents or diseases as well as the rapid ageing of the population around the world not only have an impact on productivity and profitability of enterprises, but also threaten the lives of employees [2]. One promising use case for big-data analytics would therefore be the management and prevention of occupational accidents or work-related diseases. Employee's work behaviour and health-related data can be integrated to detect correlations and patterns and recognise core drivers of human behaviour at the individual or organisational level [3]. This means that the analytics focus shifts from understanding aggregates (patterns, segments, etc.) to understanding actions and behaviour of individuals. The success of using big data for individual behaviour change and awareness creation is, however, dependent on mutual value creation for both individuals and enterprises – a big difference to traditional use cases of big data. We therefore encourage an alternative approach, one that suggests perceiving and designing such big data infrastructures as an "ecosystem" which can function properly only if the individual and organisational values are aligned and compromised.

Background

IT consumerisation is transforming the way employees work, changing their engagement and provoking a blurring of boundaries between work and private life.

The work-related use of privately owned consumer-class online services and devices is frequently referred to as "IT consumerisation" [4]. IT consumerisation is not only transforming the way employees work and collaborate, but also alters their engagement and intimacy as well as frequently provoking a blurring of boundaries between work and private life. On the one hand, as these technologies are becoming increasingly personal and pervasive, they not only serve as a "pull-and-push" information and communication system, but also as a means of recording all kinds of personal data [5]. On the other hand, IT consumerisation and strategies such as "bring your own devices" (BYOD) may also provide employees and employers with new opportunities for making use of this personal infrastructure.

Companies therefore need to differentiate between two classes of IT in use, the traditional business technologies and novel business technologies.

Nevertheless, there is an ongoing debate regarding the actual value that consumer IT can create for organisations. Exemplary issues are related to the security of business data stored on private devices or the use of consumer IT at work for non-work-related activities [6]. Thus, the blurring boundaries of work and private spheres is challenging the traditional 'business value' of IT. The traditional view of IT value defines it as "the impact of investment in IT assets by organisations on performance at different levels (network, firm, individual)" [7]. Companies therefore need to differentiate between two classes of IT in use. One class would be the traditional business technologies, which companies invest in and which are compulsory for employees to use in order to automate business transactions, such as enterprise resource planning and business-to-business applications, or which support managerial decision-making, such as expert systems and data analytics. These technologies are adopted and applied exclusively to create value for organisations.

Another class of business technologies, which we refer to as 'novel business technologies', are systems that can be owned by organisations or by employees and which, in addition to creating value for organisations, create value for employees as well. Because of privacy and other legal restrictions, organisations may not be able to force their employees to use these technologies. In this case the lack of shared values between organisations and individuals may inevitably create conflicts [8] and result in employees rejecting technology. In the following, we will describe the case of a novel business technology and how it functions by means of a real-world example.

The nature and benefits of "people analytics"

People analytics is a good example of novel business technologies and may create value for both individuals and organisations.

People analytics, which has also been called 'data-based decision-making', 'algorithm-based decision-making', or 'fact or evidence-based decision-making' is a good example of novel business technologies that may have the potential to create value for both individuals and organisations. The use of data to uncover the workplace behaviour that make employees effective, happy, healthy, creative is not a new phenomenon [9]. However, big data and the rapid development of sensing technologies such as company ID badges, smartphones, wearable and environmental sensors have revolutionised the IT market and created novel opportunities. For example, data automatically collected from employees' activities can be processed and analysed by pre-determined algorithms to make suggestions for actions.

A nice example is Google, a pioneer in both big-data and people analytics [10]. Google's people-analytics department as a part of HR tries to improve employees' wellbeing and maximise their potential contribution with the help of big-data analytics. Specifically, the 'Oxygen' project aimed at forging better managers at Google. Analytical approaches were used to derive the eight habits of highly effective Google managers from performance reviews, feedback surveys and nomination data for top-manager awards [11].

One major use of people analytics that can be observed in companies is occupational health prevention.

One major use case of people analytics that can be observed in companies is occupational health prevention. The strategic value of these technologies for businesses is obvious because companies are facing considerable expenditures due to illness-related absences such as occupational burnout or accidents. On the private level, wearable and environmental sensors are frequently used for receiving personalised recommendations, eg, for self-monitoring personal health status. The same approach is adapted to the business context, for instance by measuring the degree of physical activity at the office workplace for improving well-being and at the same time examining walking routes (eg, in logistics). However, the maximisation of individual benefits may be at the expense of company benefits and vice versa. One obvious example would be monitoring the employees' activities and health to increase productivity and reduce the economic costs of occupational and work-related injuries (financial value), which may conflict with the employees' needs for privacy (individual value). Having two distinct views of the corporate and private worlds instead of an integrated view would result in tensions. Figure 1 illustrates this issue.

Figure 1:
Value tension in "people analytics" context

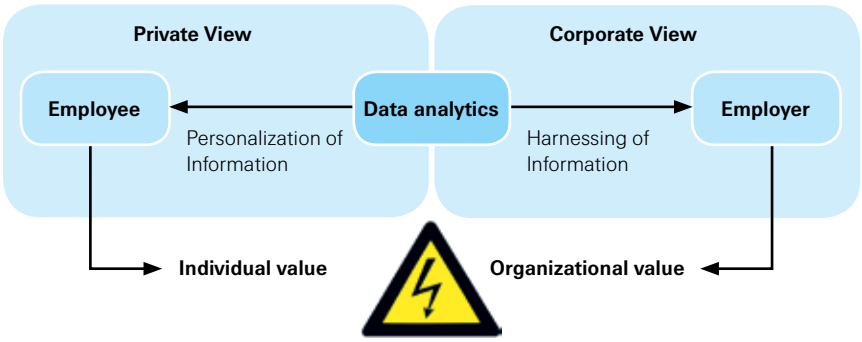
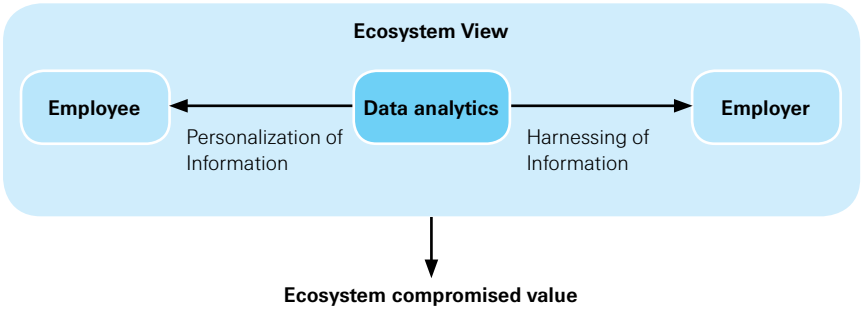


Figure 2:
A more holistic, "eco-system" perception of "people analytics"

In order to avoid a schism between different perceptions of the value of people analytics, we propose to design such systems as an eco-system right from the beginning, with all stakeholders obtaining an equal share of added value (figure 2).



The concept of affordance

'Affordance' is the utility a certain solution offers for a certain stakeholder in a certain context.

The traditional evaluation approach of IT based on the financial impact and forced adoption of business technologies in organisations results in neglect of social factors. In this case, technology is treated as a set of well-defined features that should be used in a stipulated way for achieving certain business goals. 'Affordance' is an interesting concept for understanding the social factors of solutions beyond the feature-level, as this concept gives equal weight to the material as well as social aspects of IT-reliant systems.

A simple example of affordance would be the sit-ability of a tree-stump.

An affordance as the utility of an object is what an environment offers to an organism, what it provides or furnishes, either for good or ill [12]. An affordance is a multi-faceted relational structure that is often realised via enactment of several mutuality relations among the artefact, the actor and the context [13]. A simple example of affordance would be the "sit-ability" of a tree-stump. The actualisation of this affordance depends on individual human needs, the use context as well as the tree-stump characteristics. For instance the size and the height of the tree stump should match the body size of the person who wants to sit on it. As an example for the relevance of the context, take the availability of other sit-able objects close to the tree stump. If there is nothing sit-able available, the value of the tree stump for a person is much higher than if a chair can be found right next to it.

In the case of enterprise information systems, the affordances are the actions offered by the IT artefact within its organisational context. Thus, the affordances are the result of integrating IT functionality characteristics and organisational features like organisational processes and procedures, controls, organisational culture and other social capabilities. For instance, the 'visualisation of work process' affordance as the ability to observe the actions in a work process is the outcome of the confluence of technology features (eg business process management tools, dashboards, databases, business intelligence software, real-time tracking sensors) and organisational features (process standardisation, cultural norms and reward systems) [14].

Affordance can have different impacts on employees and firms.

Different actors in the same environment can have different perspectives on an identical affordance based on their intention, expectation, motivation, needs and knowledge, which results in different action/behaviour regarding the affordances. Assuming employees and the firm to be the two main actors (subject), an IT artefact (object) in a business 'ecosystem' (context) offers an integral affordance to the employees as well as the firm. However, this affordance can have different qualities and impacts on employees and the firm (negative or positive). For instance, if we define 'traceability' (ie the ability to footprint the activities and behaviour of employees at the workplace) as an affordance, we may find that it manifests quite differently on the individual and organisational levels. Traceability helps as a means of 'self-discovery' or health-related risk prevention. On the other hand, it also may help organisations to identify behavioural patterns of employees, which in turn may be used by managers to improve the work performance and productivity of their team. However, this may result in privacy concerns on the part of employees. This discrepancy between individual and organisation-level affordances creates tensions. As we mentioned, a balance is needed so that the ecosystem functions properly. It should be the aim of system designers and firms to minimise these tensions as much as possible. The precondition for minimising these tensions would be the ability to apprehend the affordances of a technology, which are the source of tension in the context of each organisation. Then, in order to avoid the tensions, a compromised solution is required to minimise the tension to the extent that the characteristics of the technology, the user and the organisational context allow.

Illustrative case of people analytics application: Active@work [15]

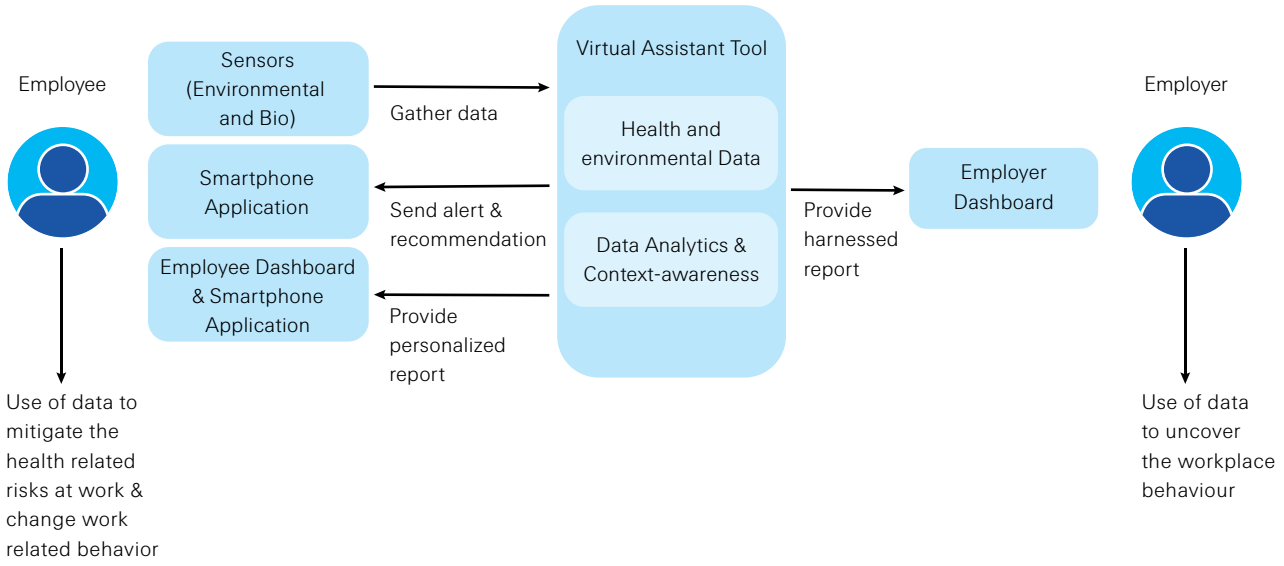
Active@work is an integrated approach to managing the negative impacts of ageing on employees' performance and productivity.

Active@work is a project funded by the European Commission and the Swiss State Secretariat for Education, Research and Innovation with the main goal of helping senior employees to do their jobs efficiently without risking their health. Active@work is an integrated approach to managing the negative impacts of ageing both physiologically and psychologically on employees' performance and productivity.

The project team is currently developing a solution entailing an innovative data integration infrastructure for context-awareness surveillance, meaning that data is analysed according to two main dimensions: the health status of each individual and the environmental conditions of the workplace. Figure 3 provides an overview of this system. To accomplish the project's goals the system will have to:

- Monitor the health status of older adults at work, through wearable devices capable of periodically collecting data (eg, ECG, glycaemia, blood pressure, pulse rate, body temperature, etc.)
- Monitor the environmental conditions at the workplace with the help of environmental sensors (eg, air quality, temperature, noise, etc.)
- Wirelessly transmit the data to a central server to be processed
- Provide operational intelligence with a proactive model and predictive algorithms for recognition of behavioural trends and early detection of personal health risks
- Trigger alert messages when the thresholds related to each individual health condition are exceeded

Figure 3:
Active@work System overview



Active@work affordances

Based on the impact on different stakeholders, we would have three different types of affordances.

In designing Active@work based on compromised ecosystem value, we need to first realise which affordances emerge from the use of the Active@work system in the organisation. In doing so, we need to understand the stakeholders' needs, as well as the system's capabilities and organisational characteristics in terms of affordances. Having drawn up the list of affordances, the next task would be to identify the impact of these affordances on the employees and organisation. Affordances can have positive or negative impacts on different stakeholders. For instance, compatibility affordance as the ability of the system to be compatible with the current technologies in use as well as work routines helps employees to seamlessly use the system (positive impact). However, frustration affordance as the ability of the system to distract and/or frustrate the employees can reduce the employee's productivity (negative impact). Based on the affordances' impact on different stakeholders, we would have three different types of affordances:

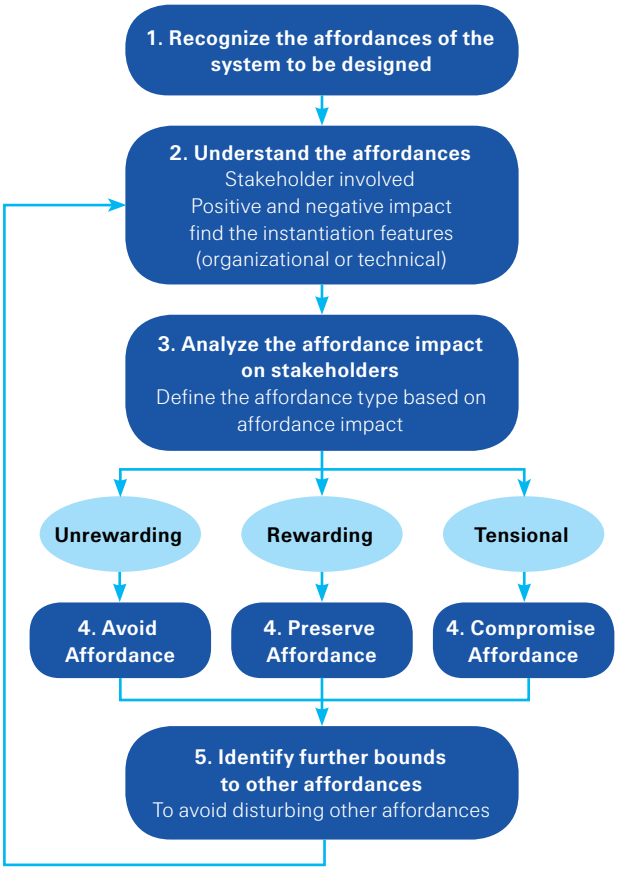
- **Rewarding affordances:** The affordances that have a positive impact on one or more stakeholders in the eco-system. The actualisation of this affordance can create value for the stakeholder.
- **Unrewarding affordances:** The affordances that have a negative impact on one or more stakeholders in the eco-system. The actualisation of this affordance can harm the stakeholder.
- **Tensional affordances:** The affordances that have a negative impact on one or more stakeholders and a positive impact on the other stakeholder(s). The actualisation of this affordance can create value tensions.

Table 1:
Typology of Affordances

		Organisational impact	
		Negative	**Positive**
Individual impact	Negative	Unrewarding affordances	Tensional affordances
	Positive	Tensional affordances	Rewarding affordances

In order to have the eco-system function properly, the goal should be to reduce the negative impact of unrewarding and tensional affordances.

Figure 4:
Affordance-based design process for an "ecosystem"



Decision-makers need to take different actions for the three different types of affordances.

For unrewarding affordances, decision makers (system designers or managers in organisations) need to ensure that the affordance behaviour will not happen. Thus, the decision-maker should specify the range that certain technical or organisational characteristics cannot fall within. For the tensional affordance, the decision-makers need to find a trade-off in specifying the technical or organisational characteristics that minimise the harm for one stakeholder and maximise the benefit for the other stakeholder. Thus, the solution component would be the result of the confluence or intertwining of technology and organisational features. Then after manipulating the organisational and technical characteristics, the decision makers need to ensure that the other affordances are not negatively impacted by this solution component. Figure 4 illustrates the above-mentioned affordance-based design process for an ecosystem.

In the following, the proposed process is applied to Active@work. The outcomes of steps 1 to 3 are illustrated by Table 2, an overview of Active@work affordances and their impacts on each stakeholder.

Table 2: Active@work affordances

Affordance	Instantiated features	Individual level		Organisational level		Affordance type
		Positive impact	Negative impact	Positive impact	Negative impact	
Traceability The ability to "footprint" activities and behaviour	Wearable and environmental sensors	Helps as means for "self-discovery", health related risk prevention	Reduces the privacy	Helps to identify the behavioural patterns of employee	Because of privacy laws it should be use voluntarily (possibility of rejection to use by employees)	Tensional
Customisability The ability to customise the system to the user needs	Algorithms Dashboard Alerts	Helps as means for receiving personalised recommendations				Rewarding
Compatibility The ability to be compatible with the current technologies in use as well as work routines	Mobile application Dashboard Alerts	Helps as means for Seamlessly use the system				Rewarding
Intervention The ability to persuade the employees to change a behaviour	Gamification Incentives Communication	Helps as means to change the behaviour		Helps to motivate employees to adopt the system and change their behaviour		Rewarding
Comfortability of wearable device	Wearable device	Helps as means to wear and stand the wearable device on daily basis				Rewarding
Improvement The ability to cope up with new emerging issues, tension, uses…	Sensors (wearable, environmental) Mobile application	Helps as means to support actions in case of emerging issues		Helps as means to support actions in case of emerging issues		Rewarding
Credibility and Accuracy The ability of offering the accurate information	Mathematical algorithm Sensors (wearable, environmental)	Helps as means for receiving trustworthy recommendations		Helps as means for receiving trustworthy recommendations		Rewarding
Injuring The ability of wearable device to injure the employees	Wearable sensors		Hurts the employees			Unrewarding
Frustration/ distraction The ability of the interactions with the platform distract and/or frustrate the employees	Alerts wearable device		Reduces the work productivity			Unrewarding

There is a need for balance between accuracy and privacy in the technical architecture of the Active@work eco-system.

Table 2 can help us to comprehend and analyse the Active@work eco-system affordances. From step 4 we start to link solution components to the various degrees of 'design' to reduce the negative impact of unrewarding and tensional affordances. For instance, in the case of 'traceability', which is a tensional affordance, the question for decision-makers would be how to find a compromise to minimise the negative impact of this tension. On the technical side, the designers need to base the technical architecture on privacy-aware monitoring architecture [16], which addresses both security and privacy issues of such technologies. However, applying this framework in designing the system may reduce the data accuracy. Data-accuracy affordance also plays an important role in this ecosystem, because without offering this affordance the value of such systems drops radically, as the health-related decisions are so dependent on the accuracy of data analysed by the system. Thus, there is a need to find a balance between accuracy and privacy in the technical architecture of the system.

On the organisational side, the incentives for participation may motivate employees to use such a system even though they might have privacy concerns. However, in defining the incentive, the value of reward should be considerable in order to convince the employees to give up parts of their privacy. Looking into the list of affordances in table 3 reveals that this organisational solution component is connected to intervention affordance, but in this case the solution component is aligned to what intervention affordance offers.

Table 3:
Active@work tensional affordance and its possible solution component

Tensional affordance	Solution	
	Organisational Solution	**Bounded Affordance**
Traceability	Incentives	Intervention
	Communication	Intervention
	Technical Solution	Bounded Affordance
	privacy-aware monitoring architecture	Data accuracy
	persuasive design strategy	Intervention

Conclusion

Companies have to rethink their notion of IT value to consider both the organisational and individual perspective on IT use.

Blurring boundaries between work and private life provide companies with new opportunities, but at the same time they also have to deal with new problems. In the case of the implantation of what we called 'novel business technologies', employees are free to decide whether they want to adopt the technology or reject it if they do not see any personal value for themselves (or they can merely selectively adopt the features they are interested in). Consequently, companies have to rethink their notion of IT value, in the sense that they not only consider the organisational but also the individual perspective on IT use.

This interdependency between private and business worlds requires altering the traditional hierarchical view of IT value. Our proposition is to perceive and analyse the value of IT in an ecosystem in which compromising and balancing values for organisations and employees can create value.

To achieve compromise between business and individual concerns, we need to understand that IT can deliver different impacts/qualities to different stakeholders in the same ecosystem. Comprehending these impacts and qualities would be the precondition for finding suitable balances in the designed ecosystem solution. Based on the presented conceptual (affordance) lens and Active@work as an exemplary application, we have proposed and demonstrated our approach to 'people analytics'.

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About the authors

Maedeh Yassaee
Maedeh Yassaee is a research assistant in the competence centre "Health Network Engineering" at the Institute of Information Management, University of St. Gallen, Switzerland. She is a doctoral student in Business Innovation at the St. Gallen School of Management. She received her M.Sc. in Information Systems, from the University of Lausanne and a B.Sc. in Information Technology Engineering from Iran University of Science and Technology. Her research interests include health information systems, health analytics, requirements engineering, IT value and system modelling.

Tobias Mettler
Tobias Mettler is currently an Assistant Professor at the Institute of Information Management, University of St. Gallen, Switzerland, where he is responsible for the competence centre "Health Network Engineering". His research interests include design science research, technological innovation, and service engineering with a particular focus on healthcare. He is the Principal and Co-investigator of several large nationally and internationally funded research projects in the area of information technology, medicine, and management. Before joining HSG, he worked for several years in industry research and consulting.

Robert Winter
Robert Winter is tenured chair of business and information systems engineering at the University of St. Gallen (HSG), director of HSG's Institute of Information Management, founding academic director of HSG's Executive Master of Business Engineering programme and academic director of HSG's Ph.D. in Management programme. He received Master degrees in business administration and business education as well as a doctorate in social sciences from the Goethe University, Frankfurt, Germany. He is vice editor-in-chief of "Business & Information Systems Engineering", senior associate editor of "European Journal of Information Systems" and member of the editorial boards of several journals including "Enterprise Modelling and Information Systems Architectures" and "MIS Quarterly Executive". His research interests include design science research, enterprise architecture management, transformation management, healthcare service innovation and the management of very large IT projects/programmes.

Laws of large numbers
Use of big data in Asian Insurance Markets

"Using affordance analysis to design individual analytics ecosystems" is an article in the Risk Dialogue Series publication, "Laws of large numbers: Use of big data in Asian Insurance Markets", published by the Swiss Re Centre for Global Dialogue. The publication features experts from different markets and regions discussing how insurers are currently employing big data techniques in Asia, and where future trends might be heading. Other articles in this report include:

- **Data protection and privacy**
  Data on individuals may be physically collected in one jurisdiction, stored temporarily in another one and processed in yet a different one. Personal data-protection and privacy laws differ across different countries. Unquestionably, distinct legislations and different compliance postures from governments throughout the world make the realisation of potential benefits from big data into a serious challenge, particularly for global companies. After more than two decades of experience, it is clear that the European Union and the United States have very different and irreconcilable positions in terms of information privacy rights and related regulatory practices. The question is whether these differences in information privacy across the globe will open up unexpected opportunities for Asian countries to attract new business from the other two giant regions in the world.

- **Big data and crop insurance in Asia**
  Administering crop insurance in Asian countries with small fragmented agricultural land holdings is an expensive affair, but costs can be substantially lowered through the introduction of index-based or parametric insurance schemes. These are managed, however, by means of relatively generic data measurements that do not always capture the experience of individual farmers. The introduction of new data technology services into agriculture, in the form of increased sensor data volume, refined data processing, and far greater mapping accuracy, can provide a much more detailed picture of risk at the farm level. Technology can provide a rich source of underwriting and loss-assessment data for insurers to improve their index as well as indemnity products. Joint efforts are, however, necessary to ensure that data remains accessible in order to reap the full benefits.

- **Interesting experiments on big data in China**
  There is little doubt about the bright future of applying big data in the insurance industry in China. Almost all insurers in this market have entered the competition to craft big data strategies. But before insurers are able to see any concrete progress, they have to overcome the obvious barrier of data shortage. Data shortage is a direct result of the short history of the insurance industry in this market. The lack of high quality data is also due to the limited capabilities of insurers in data management, analysis and processing. Nevertheless, nothing will stop insurers in China from embracing the big-data era. Among all kinds of interesting experiments, cross-industry integration will be the best strategy going forward. By utilising the strength inherent in underwriting and risk control, insurance companies may unlock the untapped demand for insurance by collaborating with companies in other industries who have high-quality data.

- **From personalised medicine to personalised prevention**
  Whilst personalised medicine is only a recent concept, personalised prevention is already pointing us in a new direction. We can, with big-data approaches and predictive algorithms, finally manage the health status of each individual based on their unique set of characteristics, and we can recommend specific actions to them in real time to improve their individual prognoses and prospects. DEMOS, Demographic and Epidemiological Model of Singapore, simulates the population of Singapore, at the individual level, taking in possible future scenarios and the probability of their occurrence, as well as evaluating the effect of various interventions that may be attempted.

- **Big-data analytics and evidence-based healthcare**
  The healthcare industry is moving towards an evidence-centric healthcare ecosystem, which is key to shifting healthcare towards lower costs and better outcomes. Enabling the vision of truly evidence-based healthcare will require critical investments for turning the huge amount of structured and unstructured healthcare data into care insights that will support evidence-based practice. Big-data analytics technology is the core of the healthcare transformation, and impacts the evidence-centric healthcare ecosystem. The adoption of big-data analytics is the key component to enable the evolution.

By looking into the different aspects of developments in and applications of big data in Asia, this report provides a vivid picture of where the market is going and how the insurance industry could readjust itself to tap into the ongoing change and growth process.

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Swiss Re Centre for Global Dialogue
Gheistrasse 37
8803 Rüschlikon
Switzerland

Telephone +41 43 285 8100
Fax +41 43 282 0139
global_dialogue@swissre.com
www.swissre.com/cgd