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Re-Think Insurance: A New Perspective of InsurTech

Julian Yu
Nanyang Technological University, Singapore, jfcyu@yahoo.com.sg

Benjamin Yen
The University of Hong Kong, China, benyen@hku.hk

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Re-Think Insurance: A New Perspective of InsurTech

(Full Paper)

Julian Yu*, Nanyang Technological University, Singapore, jfcyu@yahoo.com.sg
Benjamin Yen, The University of Hong Kong, China, benyen@hku.hk

ABSTRACT

Technology improves performances of industries generally. While some applications impact insurance industry profoundly, however, some of the improvement is more of office automation and is better not classified as InsurTech. The article is to provide a practical perspective of InsurTech from the review of definitions and purposes of insurance, and the induction of risk information and risk financing, to silhouette insurance ecosystem and framework of InsurTech. Under risk information, the information layering is explored and the basic three elements of risk, contract and portfolio are identified in insurance ecosystem; under risk financing, transaction costs of insurance and law of large numbers are applied. Then, we propose a framework based on the three elements for InsurTech in regard of availability, affordability and assurability. Two approaches are also proposed for InsurTech development - evolutionary way to revise specific areas of the current insurance models and revolutionary way to revamp the insurance models as to redesign the arrangement of risk protection.

Keywords: InsurTech, risk information, risk financing, insurance ecosystem, assurability/insurability, availability, affordability, law of large numbers.

*Corresponding author

INTRODUCTION

In this paper, definitions, purposes and mechanisms of insurance are reviewed to outline a picture of risk protection operation and stake-holding entities' relation in insurance. Exploration is based on two major considerations, risk information and risk financing, to identify the basic elements of insurance ecosystem and features of framework of InsurTech. For risk information, it is important to adopt standards (e.g. EDI) allowing easy conversion of existing accumulated data and future expansion to connect with more data sources (e.g. IoT), and then consequently to improve the availability of risk information. For risk financing, it is critical to reduce transaction costs and to use Law of Large Numbers to improve affordability of insurance. Advancements of both will lead to improve assurability to broaden insurance application scope. From these observations, we define insurance ecosystem as "business activities with at least one of the three elements of insurance, namely risk, contract and portfolio". We further define InsurTech as "technologies to change the insurance operation for better insurance acceptance and portfolio management to improve availability, affordability and assurability". This helps to distinguish insurance evolution from other office automation. It also helps to evaluate the potential or importance of new technologies to the core value of insurance. The clarification is an attempt to make InsurTech adhering to core issues of insurance. Applications can be: (1) to improve the current business model by reviewing key points of generating profit; and (2) to redesign the protection arrangement as a new insurance business model.

LITERATURE REVIEW

In last decade, much attentions have been drawn on FinTech from both academic and business world. Many papers are discussing about InsurTech, the insurance-specific branch of FinTech initiatives. Following reviews are grouped into: (1) needs and opportunities, (2) technology adoption, and (3) risks and challenges.

(1) Needs and opportunities. Several studies discuss the needs and opportunities of insurance industry to explore for changes. Agrawal *et al.* point out US life-insurance industry should seize the opportunity for a huge market and conclude the challenge is in the execution to best weather the inevitable storms while continuing toward their ultimate goals (Agrawal, de Gantès & Walker, 2014). Johansson and Vogelgesang (2016) study the impact of automation on insurance industry and they conclude probably 25% of full-time positions in the insurance industry may be consolidated or replaced. Rodríguez Cardona *et al.* (2019) discussed the adoption success of Chatbot Technology in German insurance sector depending on the understanding of the ambivalent perceptions, attitudes, and beliefs of the main social actors (i.e., practitioners and potential users) towards the customer interface. Yan *et al.* (2018) survey the landscape of insurance technology and its potential from the perspective of enablement for financial and insurance services. Wilson (2017) describes the future of insurance from viewpoint of technology trend and concludes if forward-thinking banks that are able to leverage InsurTech appropriately, it may enhance profitability and valuation over long term.

(2) Technology adoption. Many papers focus on the track of technology adoption in insurance industry. Beath *et al.* (2018) studied a case of a company of merger of two banks and an insurance company exploited new data science and machine learning disciplines to transform for better customer service. Loebbecke *et al.* (2018) studied the adoption block chain in

diamond industry with customers and insurance company. They found block chain substitutes and complements for trust when trading diamonds. Yu and Yen (2018) incorporate the concept of a cryptocurrency, called Risk Coin, as the foundation of a new model to enhance the risk financing efficiency with capital market. Chester *et al.* (2016) advocate insurance carriers and actuaries should adopt the advanced analytics on top of the existing analytics in practice and explain the four-stage journey for adopting advanced analytics.

(3) Challenges. Some papers highlight the challenges and risks issues for insurance industry. Catlin *et al.* (2018) explain the challenging digital transformation in insurance industry needs to ensure the continuity of the flow of daily business. Collins (2018) points out the penetration rate for insurance in China remains low compared to Western measures and there is plenty of headroom for growth in the China market. Onno Bloemers (2018) concludes insurers need to evolve into organizations offering a much broader set of risk management solutions. Passler (2018) discusses the key differences that are potential to deeply change, or even disrupt, the insurance industry.

In the above most of the studies concentrate on the future trend, conceptual framework, and impact study. A recent white paper for reinsurance blockchain described the issues of information imbalance in risk transferring and low level of digitalization in reinsurance transactions (Zhong An Technology, 2018). The challenges of identifying the scope and strategy of InsurTech is still the focal point. In this paper, we propose a framework of risk information not only important for the operations and decisions in insurance industry and but also crucial for standardization in realization of InsurTech.

INSURANCE – DEFINITIONS AND PURPOSES

Technology has influenced insurance operations in many ways. People expect further applications of InsurTech will lead to significant improvement or even revolution for insurance business models. To provide a clear perspective of InsurTech, it is imperative to review the fundamentals of insurance, including its definitions and purposes. First, a "risk" is the possibility of losing something of value, therefore treated as a potential financial burden of uncertainty to the responsible entity called "risk owner". If a risk is considered insurable, the risk owner can choose to transfer the financial burden to another entity called "risk carrier" (usually insurance company) by insurance arrangements, and the financial burden becomes risk carrier's responsibility (Figure 1).

Figure 1: Insurance Market for Insurable Risks

However, if the risk is not insurable or the price of the insurance is unaffordable, the financial burden is then retained by the risk owner. In this situation, the financial loss resulted from the risk is sustained by risk owner and its investors if any. There are various definitions of insurance, which can be grouped into two, namely legal definition and financial definition. Each one provides different focus of insurance and therefore introducing different aspect of value chains.

Legal definition of insurance for risk transfer

A common definition is legal viewpoint of insurance being a legal contract for risk transaction, and the definition can be as following:

<u>*Legal Definition of Insurance*</u>

Insurance is a contract in which one party agrees to compensate another party for losses. We call the party agreeing to pay for losses the insurer. We call the party whose loss cause the insurer to make a claim payment the insured, policyholder, or policy owner. We call the payment that the insurer receives a premium, call the insurance contract a policy, and call the insured's possibility of loss the insured's exposure to loss.

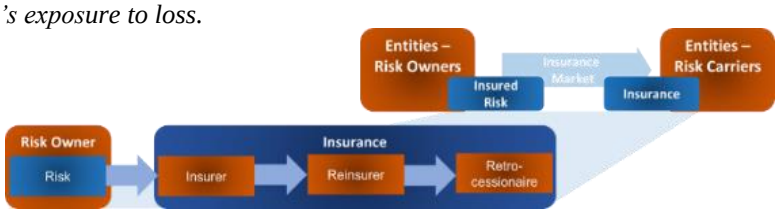

Figure 2: Insurance Process described by Legal Definition

The value chain in risk transaction process by formal legal contracts between different entities is as in Figure 2. According to the contractual requirements, original risk owners pay risk premium to insurance companies, who pay reinsurance premium to reinsurance companies, and then to retrocessionaires, etc. By contractual requirement, claims payments are conducted in the reverse direction. Under legal definition, contracts of direct insurance policy, reinsurance and retrocession arrangements, portray

the outlook of today's insurance industry, and manifest following issues. One is Information asymmetry, referring to resolution reduction of risk information in each step - risk owners have the best resolution of risk information that reducing along the process either intentionally or by restriction of technology and management tools. The other one is duplicate investment that each entity in the value chain performs similar functions of information collection and risk assessment.

Consequently, the iterative transactions of insurance are often considered a zero-sum game, due to high transaction costs along the value chain. During the loss claiming stage, the insured tend to hold the mentality of externality as risk carriers are separate entities sharing no common interests. All these make insurance market less efficient. Nonetheless, the legal definition provides a strict and microscopic view of contractual activities as how entities are involved in insurance operations. However, it does not express clearly the differences of insurance comparing to other financial contracts, which calls for the financial definition of insurance.

Financial definition of insurance for risk financing

Financial definitions highlights risk pooling and loss sharing functions of insurance, two versions listed below for a complete description:

Financial Definition of Insurance - *(1) Insurance is a financial arrangement that redistributes the costs of unexpected losses. (2) Insurance involves the transfer of potential losses to an insurance pool. The pool combines all the potential losses and then transfers the cost of the predicted losses back to those exposed.*

In these definitions, the value chain focuses on risk-sharing function among all participants, including risk owners joining the risk sharing pools, and financiers supporting risk reallocation, as illustrated in Figure 3. The entire reallocation process is iterating into direct insurance, reinsurance and retorcessionaire as described by legal definition. Legal and financial definitions are complementary to provide a complete picture of both risk transferal and financing mechanisms. Risk transferal mechanism includes the underwriting function to decide premium rate and collect premium from the insured/ original risk owners if it is direct insurance; or the reinsured/ cedant (risk carriers to be reinsured) if it is reinsurance/ retrocession iteratively, which is then pooled as the loss sharing fund providing certain profits for financiers. Ideally, proper risk premium is charged for individual risks and collectively appropriate to fund predictable losses. Claim function will then follow the reverse distribution to reimburse the claiming insureds/cedants. Risk financing mechanism is the process of loss reallocation – (1) risk pooling to form a portfolio for reallocating predicted losses among all participants, and (2) financiers cover the differences of predicted loss amount and loss amount beyond underwriting prediction.

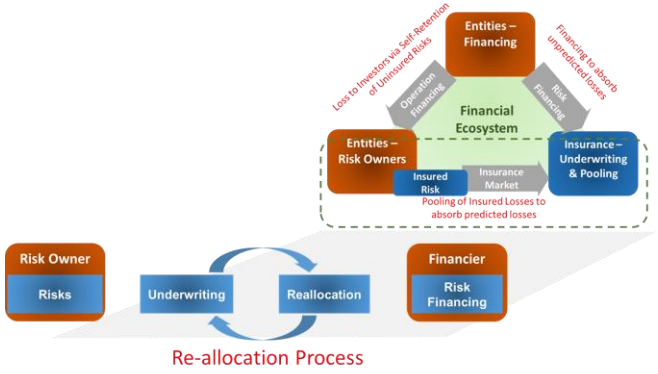

Figure 3: Insurance Process described by Financial Definition

Figure 3 illustrates stakeholders as entities performing risk pooling function for absorbing predicted losses and risk financing function for unpredicted losses. Moreover, the figure extends to losses from the uninsured risks born by risk owner then forwarded to its investors. In a broader sense, all losses are born by financial markets either through insurance by risk financing or self-retention to investors as operation financing, which form a complete risk sharing picture in the financial ecosystem.

Benefit of insurance is to reduce the overall required risk capital, for the insured risks are in a risk pool to gain the benefit by Law of Large Numbers. In addition, the required capital for professional risk carrier is usually regulated to match its risk preference and strategy to further enhance its returns. Therefore, from financial point of view, insurance is a more effective way of risk management.

Stakeholders' requirements in insurance

Stake-holding entities' requirement in insurance are also explored to outline a new perspective of InsurTech. They are risk owner, risk carrier and risk financier in the financial ecosystem as illustrated in Figure 4.

Requirements in Insurance – (1) For Risk Owner: To obtain require protection at affordable price. A wider range of insurable risks is preferred to reduce the potential loss to risk owner and investors. (2) For Risk Carrier: To obtain risk information for underwriting, of proper risk rating for a profitable homogeneous risk pool by Law of Large Numbers. (3) For Risk Financier: To gain adequate return for invested capital with the least uncertainty of loss from the invested entities or risk pools.

From the above, we identify two major areas for improvement as follows.

(1) *To improve efficiency:*

- Risk Information. Availability by better information resolution of risk for underwriting and portfolio management.
- Risk Financing. Affordability from reasonable loss re-allocation and fund-raising efficiency with incentives for stakeholders.

(2) *To enhance use of insurance:*

- Uninsured Risks. Assurability of uninsured risks as subject of analysis to reduce undesired uncertainty and improve overall capital efficiency.

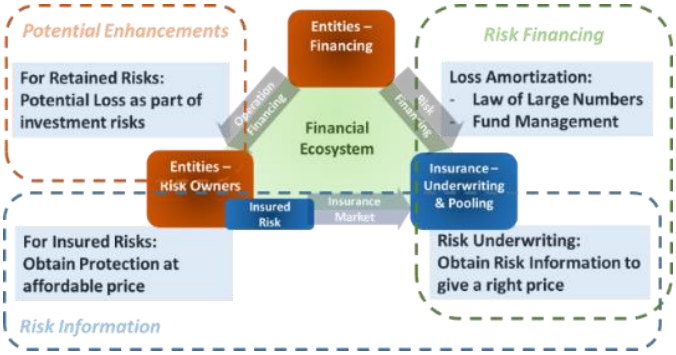

Figure 4: Requirements of Insurance by Stakeholders

In this paper, we explore these two issues in the insurance ecosystem and to review the structural knowledge of Insurance, to define the scope of InsurTech and its potential development for the purpose stated in this section.

RISK INFORMATION FOR INSURANCE

Insurance value chain composes iterative steps of risk underwriting and risk reallocation, and each step repeats complete risk transaction deal, including charging adequate premium and providing agreed limit of liability of coverage. To get the adequate premium, it requires the selection of an appropriate premium calculation base with a premium rate derived from statistical analysis of similar risks. During the risk transferal operation two objectives are achieved – calculating the premium for this specific risk transferring and enhancing the rating databases for future similar risks. The selection of premium calculation base is to find an adequate quantifiable index of risk, which shall be able to reflect the size of the exposures of the risk, so that the premium can be a reasonable monetization for the coverage and limit of liability. Collection of risk information is also important for a portfolio, that the performance of the portfolio can be reviewed to make necessary adjustment for future risk acceptance, as illustrated in Figure 5.

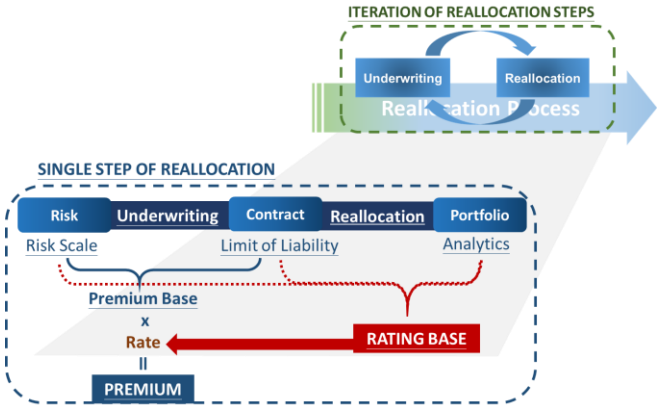

Figure 5: Single Step of Risk Transferal Operation

Risk acceptance process is composed of two complementary functions: underwriting to make use of rating base applied to selected index of a specific risk for premium calculation; and actuary to apply analytic statistics on an actual or virtual portfolio of risks and

contracts to build or maintain the rating base. The performances of both functions depend on the quality of risk information. Obviously, the improvement of technology to access and process risk information will change insurance product design. Especially the availability of real-time risk information provides more options of premium base. For example, the Usage Based Insurance of automobile policy, its coverage and liability is only activated when the vehicle is driven on road, and the drive-on-road duration is taken up for premium calculation with other traditional factors, e.g. monetary value, year of make, and vehicle model.

With more real-time information available from increasing popularity of technology, such as Internet of Things (IoT), it is believed that traditional insurance products will be revamped for more affordable arrangements. Moreover, the assurability criteria can be reviewed for traditionally non-insurable risks that may become insurable under new arrangements. Therefore, the technology which provides information as premium base for more effective insurance product to improve affordability shall be qualified as InsurTech

Risk information under insurance operation

Current model of insurance has been through few modifications. Under this model, risk information is collected manually for underwriting decision, and information systems are designed to process accepted risks only for contract administration mainly. Moreover, claims and reinsurance functions are usually loosely integrated or completely in separate systems. Consequently, the availability of risk information is very limited as illustrated in the diagram of Figure 6.

The risk information, including both insurable and non-insurable risks, can be classified in four layers by availability as: (1) Recorded Information of Insured Risk. It usually is limited and inconsistent for both inter-company and intra-company transactions. (2) Insured Risk Information. Information of insurable risks with coverage terms quoted by risk carriers and accepted by risk owners. (3) Insurable Risk Information. Information of risks that are considered insurable by risk carriers under criteria of current insurance operation. (4) Non-Insurable Risks.

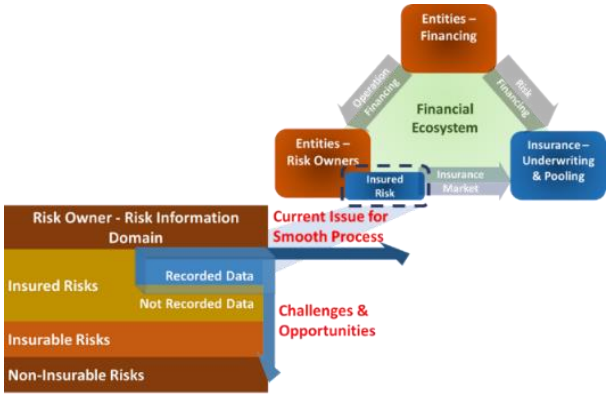

Figure6. Available Information for Insurance Process

In Figure 6, there are two issues:

- Lack of smooth process of insurance operation sharing information with different systems, due to missing data sharing standard for insured risks through insurance processes and transactions between different risk carriers via reinsurance etc. InsurTech is expected to provide a solution on this issue to expand better use of available data for underwriting decision and claims handling.
- Challenges and opportunities coming with more available risk information from improved connection with data sources (e.g. IoT) to collect information of non-insured and non-insurable risks. InsurTech is expected to change from a reactive approach to a proactive one to pave way for more effective data mining of data utilization (Figure 7).

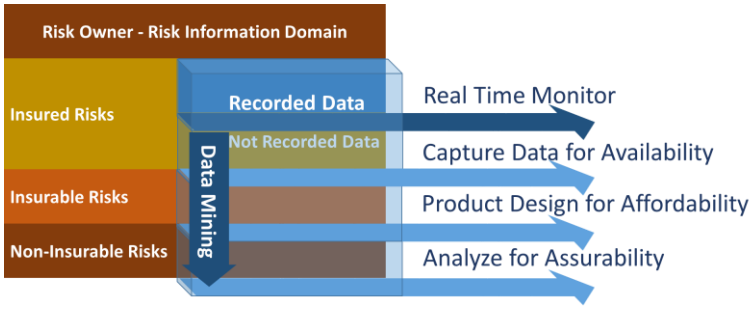

Figure7: Data Mining of Risk Information

Abundant, reliable and timely risk information will change the landscape of insurance contract design, with enhanced risk information enabling insurance contract more efficiently executed, and contract performances more promptly summarized for portfolio analysis. The broader spectrum of information will make actuarial portfolio analysis advancing from descriptive analytics to predictive analytics, or even to prescriptive analytics with real-time information for real-time decisions. All these will benefit both risk carriers and risk owners, to enable insurance to handle broader domain for non-insured or non-insurable risks. Wider range of information are then processed via actuarial analytics for simulations and comparisons with rules derived from portfolios of insured risks. Such application of information technology enhances the availability of risk information and continuously improves the affordability and assurability of insurance products. Therefore, we can conclude that the enhancement of availability, affordability or assurability is one important requirement for InsurTech.

Risk information in insurance ecosystem

Although insurance operation is part of financial ecosystem, it is helpful to define the scope of insurance ecosystem so to distinguish from other financial operations. As risk is the essence of insurance, it is necessarily included in the insurance ecosystem. Extensions can be derived from management and utilization of risk information via the processes described in legal and financial definitions:

- Legal definition: Insurance as a process to retrieve risk information for contract execution including underwriting, claims settlement etc. which repeats in reinsurance and retrocession to distribute covered risks to risk carriers along the value chain;
- Financial definition: Insurance as a process to utilize risk information to distribute losses from collected risks via insurance and reinsurance arrangements of risk carriers' portfolio to achieve the desired sharing performance.

Figure8: Ecosystem of Insurance

From the above, insurance contract under legal definition and risk portfolio management under financial definition are also critical. Therefore, risk, contract and risk portfolio represent the elements in the insurance operations, to provide the landscape of insurance ecosystem. For any issue irrelevant to the three elements, it is not for insurance consideration. For example, financiers comparing performance of a particular investment portfolio with other industries is in the domain of investment rather than insurance. Another example is IoT applied in manufacturing facilities that provides torrent of risk information regarding facilities, could potentially be an issue for insurance if a contract can be formed with rating mechanism and coverages for the exposures. All insurance activities are involving one of more of the three elements, constituting insurance ecosystem as show in Figure 8.

The ecosystem framework provides a useful demarcation of InsurTech, that activity with little consideration of the three elements is irrelevant to insurance. For example, photocopier replacing handwriting on carbon papers surely improved overall performance, but such improvements are irrelevant to the three elements and therefore does not impact on insurance business models. Another example is facial recognition if it is not used to improve underwriting or claims settlement shall not be InsurTech.

Risk information and InsurTech

Risk information essentially connects risk, contract and portfolio, and for potential improvement in insurance contract design and portfolio analytics. Technology that helps improve in these areas are potentially qualified as InsurTech. The fundamental work is an information exchange standard (e.g. EDI) for availability of risk information. Such standard will allow smooth information sharing within insurance industry and external sources, therefore pave a way to an environment of highly connected operations in the insurance ecosystem. With the increase of availability, more proactive exploration to increase the data value will encouraged, which will lead to improve the affordability of coverages and eventually enhance the assurability.

The commonly used Internet nowadays can be considered as Internet of People (IoP) which has already changed social connection of people and triggered revolution in many industries (e.g. retailing and banking). Similarly, the implementation of IoT will also change industries which are focusing on operation or connection of constructions and apparatus. The accumulated data, externally or in insurance industry, can be used to support of underwriting activity as a goldmine for the discovery of un-manifested actuarial

principles, especially once the cross-reference is established with risk information that has not been captured in the past. This requires easy data conversion that the EDI needs to be well defined in a flexible way as building blocks to contain variable risk information formats across insurance with other industries. Insurance industry will eventually benefit from the implementation of an overall digitalized ecosystem. However, it will make thing happened easier if insurance industry liaises the appeal of InsurTech for other industries' purposes, that insurance can be the guidance of information integration for general purposes.

The cost reduction can also a driving force that development and maintenance of insurance information system are increasing. Together with the requirements to handle growing interactions, the EDI standard can be the groundwork for open API standards or shared OS to drive the system cost down. Moreover, abundant risk information together with security technology like blockchains may dramatically increase information volume and stringent requirement of sharing common information. One potential solution to reduce the cost is risk information sharing in Cloud for underwriting decisions and other actuarial analysis, which can be achieved easily in an EDI environment.

RISK FINANCING

Two ways for loss financing from a risk: one is by insurance market for insurable risks with affordable premium, the other is by financial market for risks considered uninsurable or with unaffordable premium and therefore self-retained by risk owners and their financial supporters. For risks placed to insurance market, losses are transferred to risk pools with volatility reduction by Law of Large Numbers which allows less capital for financial protection than the summation of capital required by individual risk owners if self-retained. Such transferring can repeat that Risk Carriers can reduce their volatility to reach a desired level of risk homogeneity. To avoid confusion, insurance within overall business relations are illustrated in Figure 9.:

- Insurance Market: Risk accepted by entities other than the risk owners via transferring contracts of insurance, reinsurance or retrocession.
- Financial Market: Risk retained by owners with their creditors via by ownership or debt/bond, etc. Also, insurers are financed by Financial Market.

Figure 9: Complete View of Risk Sharing

Equivalence equations of insurance operation

The traditional equivalence equation (Borch, 1984) is extended to financier's involvement as:

Equation 1

$$\Sigma_t W_t + \Sigma_t \Sigma_s Claims_{s,t} = \Sigma_t X_t + \Sigma_t \Sigma_s Premium_{s,t}$$

- Σ_s: Summation of premiums or claims, footnote s indicates different insureds;
- Σ_t: Summation of amounts for a period of insurance usually by years, footnote t indicates different years;
- Risk sharing by pooling of all premium and claims, and by certain periods of continuous years;
- Profit or loss of the pool to the investors who will adjust by W_t and X_t on annul basis.

For individual insured:

Equation 2

$$\Sigma_t w_t + \Sigma_t Claim_t = \Sigma_t x_t + \Sigma_t Premium_t$$

- Footnote s is fixed;
- Over a certain period, it is ideal to approach equilibrium as $\Sigma_t Claim_t = \Sigma_t Premium_t$;
- Premium before significant claims is decided by underwriting from previous experiences of its own and similar risks;
- Premium after significant claims is increased in following renewals to "payback" claims payment.

Modified Equation for Financial Definition:

Equation 3

$\Sigma_t \Sigma_s Claims_{s,t} = \Sigma_t \Sigma_s Premium_{s,t} + \Sigma_t (X_t - W_t)$

- W_t and X_t are summations of w_t and x_t for individual insureds, to demonstrate Risk Financing from Risk Capital;
- Premium pooled to share predicted losses, and risk capital as additional fund for unpredicted losses;
- Law of Large Numbers to stabilize returns.

For transaction cost and loss/profit of portfolio:

Equation 4

$\Sigma_t (W_t - X_t) = \Sigma_t \Sigma_s Premium_{s,t} - \Sigma_t \Sigma_s Claims_{s,t}$

- Loss/profit generally is an issue of daily underwriting management;
- However, transaction cost included in the above can be an issue of overall environment and technology.

Transactions Costs of insurance

"If Insurance is efficient to reduce volatility, why we still do self-retention for some or part of the risks?" (Coase, 1937). Insurance protection can be considered as time based rental contracts of risk financing capital. Therefore, we can apply the concept of Sharing Economy to treat self-retention as "owning" and insurance as "renting" the required protection.

Transaction costs for insurance can be explained as:

- *Transfer Cost*, to match demand and supply, e.g. brokerage and commission;
- *Triangulation Cost*, to collect information for underwriting and claims decisions, e.g. loss survey;
- *Trust Cost*, for potential failure of contract execution, e.g. capital cost to improve the solvency.

The costs mutually correspond to each other. For example, parametric products to simplify loss measurement (reducing triangulation cost) cause concerns of not reflecting true scenarios and may impact support from lacking trust (increasing trust cost). Another example is Finite Risk Reinsurance (reducing triangulation cost), requiring obligation for multiple year agreement (increasing trust cost). Currently InsurTech focuses on transfer cost as it is easier to be observed, though triangulation cost and trust cost are also important to market efficacy. A conceptual diagram (Pearson, 2019) is an excess of loss reinsurance arrangement to explain reinsurance transactions usually made for middle layers, as high costs hamper the transaction for primary layer from frequent losses (losses of short return period) and for high layers from extra-large scale losses (losses of very long return period), as illustrated in Figure 10:

- X axis - loss amount specified by return period of loss, longer return period represents higher loss amount.
- Y axis - transaction cost by triangulation and trust are, assuming no or fixed transfer cost.
- Triangulation cost is from high left to low right, as usually it is harder to measure daily work for small losses with high frequency, while it is relatively cheaper to estimate loss of longer return period by catastrophe modeling.
- Trust cost is from high right to low left, as usually it is less concerned on small losses and critical for solvency issues. Losses of long return period may be omitted and reducing predicted loss range, to call for financial support with increased trust cost.
- Summation of triangulation and trust costs is high at both ends, explaining such protection is usually for middle range. Each cedant has its own preference as illustrated in red lines that Cedant B prefers lower layer protection than Cedant A.

This diagram also indicates potential effects of technology, that improving risk information availability will probably help reducing triangulation costs, while blockchain applications should probably focus on trust cost over solvency or large losses.

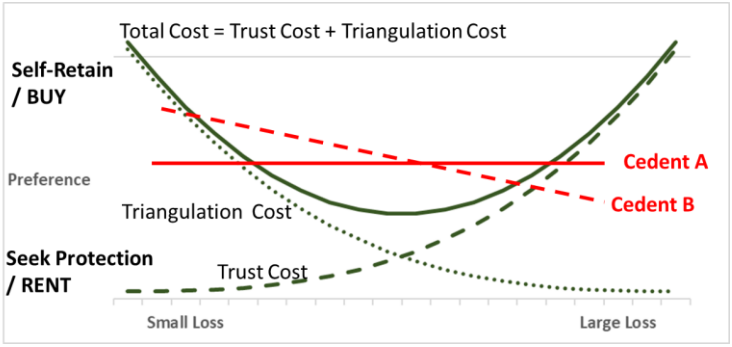

Figure 10: Triangulation Cost and Trust Cost in Excess of Loss Arrangement

Law of large numbers and insurance ecosystem

Uncertainties can be reduced by better quality or management, but not possible to be eliminated completely. To manage uncertainty at least for financial impacts, Law of Large Numbers LLN is applied. Quality and quantity of risk pools are affecting

the performance of LLN. To simplify our analysis, quantity is defined as number of risks, and quality is defined as the similarity of risks to manifest the inherited nature by the availability of risk information. Both requiring insurance companies to allocate limited resources in collecting risk information or soliciting risk owners as clients. The limited resource forms line segments in Figure 11 that more risk information collection will reduce the solicited number of risks. Each company's curve sits at different position as insurance or reinsurance companies due to its expertise, scale and capital strength. When seeking reinsurance support, cedants present their portfolio to reinsurers benefitted by less effort in collecting risks but with less risk information resolution due to cedants' abstract risk presentations, contractual requirement, or technology restriction for reinsurers to process detail information. The exchanges forms Risk Transfer Curve in Figure 11, that cedants have better resolution in Risk Information while reinsurance companies have advantage in Number of Risks, and transactions occur when both parties benefitted from the deal.

InsurTech is expected to improve availability of risk information for improvement in risk pricing and selection. Such improvement will change resource line segments to become flatter as in Figure 12. Since the improvement is open to all companies, a new risk transfer curve may appear as the red solid line on the right in the figure. However, such curve does not indicate a stable market as all companies have similar level of risk information, and therefore resulting to fierce competition on soliciting risks. Boundaries of insurance, reinsurance and retrocession will probably become vague if not totally vanish.

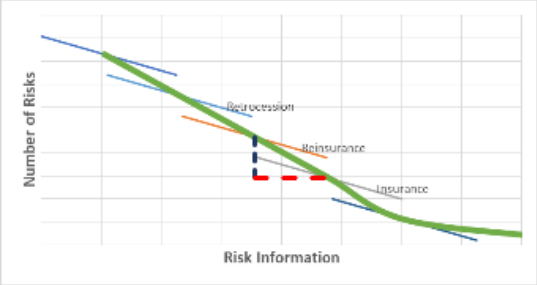

Figure 11: Company Resource Line Segment and Risk Transfer Curve

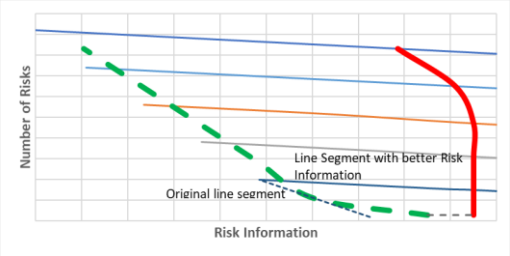

Figure 12: Resource Curve changing with increasing availability of Risk Information

The competition is likely to generate a spiral effect to enhance further competition to improve affordability of insurance products and assurability to narrow up protection gap.

PERSPECTIVE OF INSURTECH

The deployment of technology helps in many ways and some may improve the overall efficiency of human society. For example, the photocopier replaces duplicate hand-writing documents, and computers assist actuarial calculation for catastrophe simulation. However, if any technology applied in insurance is called InsurTech, this term will be vague and probably misunderstood.

To be a meaningful perspective of InsurTech, three important characteristics shall be included:

- *Availability*. Risk information and insurance products available for transaction decision.
- *Affordability*. Transaction cost reasonable for risk owners and profitable for risk financiers.
- *Assurability*. Law of Large Numbers applied to broader range in products and innovated insurance models.

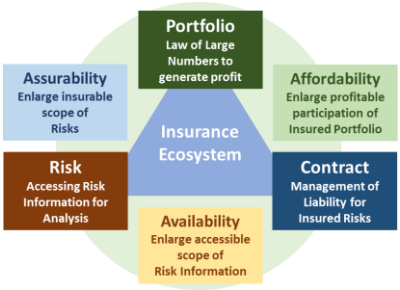

Figure 13. Elements of Insurance Ecosystem and Features of InsurTech

A framework of InsurTech is then proposed:

Technologies to improve availability, affordability and assurability of insurance ecosystem that is composed of risks, contracts and portfolios for loss sharing and volatility reduction.

This framework highlights the core value of technology to provide guidance in resource allocation for InsurTech implementation within insurance ecosystem, as illustrates in Figure 13. Based on this framework, we are able to explore the potential of InsurTech in: (1) improving current business model and (2) redesign business model.

Improving current business model

We are reviewing current business model in the critical steps of insurance value chain, and the potential improvements in information management as following.

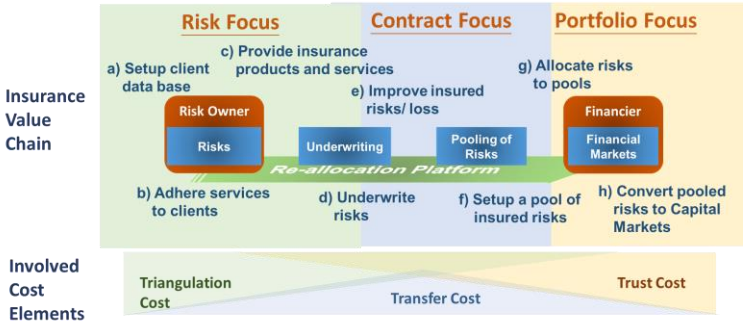

Figure 14: InsurTech to Improve Current Insurance Model

In the insurance value chain shown in Figure 14, eight activities are highlighted for making profit or saving cost under current business model: (a) Setup data bases of potential clients; (b)Adhere services to the target clients; (c) Provide products and services to the clients; (d) Underwrite risks; (e) Risk improvement before or after losses; (f) Setting risk pools by retention or treaty; (g) Allocate risks to pools by Law of Large Numbers; and (h) Convert insurance portfolio to financial market. A technology is classified as InsurTech in these activities if it has significant improvement on availability, affordability or assurability. For example, Internet marketing helps in steps (1), (2) and (3), but it is a general marketing tool for all kinds of products or services, not necessarily qualified as InsurTech unless it assists efficiently in risk information collection and transmission for underwriting assessment and risk condition monitoring, it is improving risk information availability and then qualified as InsurTech.

Figure 15: Information Management for Insurance Industry

Also, we can review the potential improvements of in information management in following six layers as shown in Figure 15: (1) Credit Information; (2) Settlement Management; (3) Technical Accounting; (4) Policy & Placement Management; (5) Risk Exposure Information; and (6) Background Information. Technology is considered InsurTech if it helps improving the efficiency for the management in each layer, or the linkage of information between layers. For example, the EDI for insurance operation is a proposal to link components (3), (4) and (5) (Yu & Yen, 2018).

We can also combine these two to review technology applicable to insurance. Current IT mainly focuses on the reduction of transfer cost, and it may require external connections for reduction of triangulation cost and trust cost.

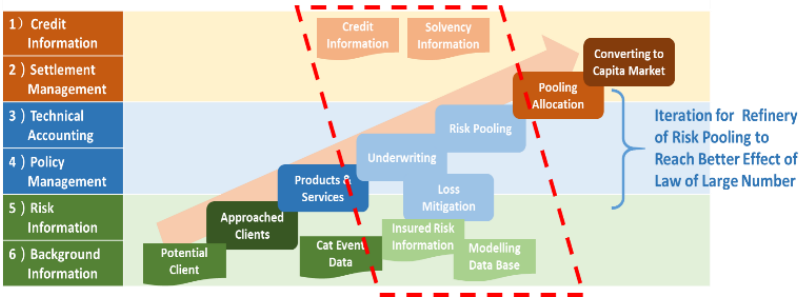

Figure 16: Evaluation of New Technology in Value Chain

Moreover, to evaluate the potential application or impact of a new technology, we can check areas less aware or worked upon in the value chain (Figure 16), or in the data structure (Figure 17).

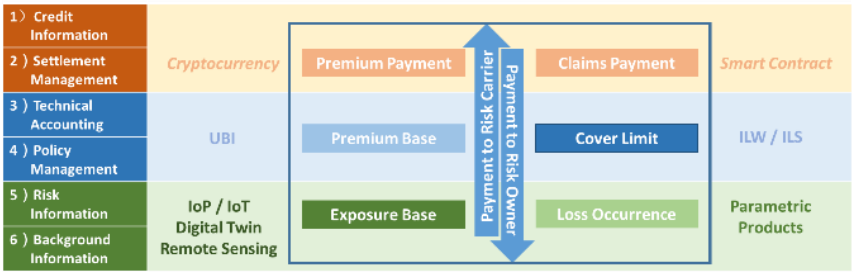

Figure 17: Evaluation of New Technology in Data Structure

Redesign business model

Technologies which helps in the process from accessing risk information to risk financing will assist in redesigning insurance model. From the proposed definition of InsurTech, we can expect the redesigned model to achieve the objectives set in the framework:

- *Availability*. Access required risk information of insurance processes on universal platforms.
- *Assurability*. Research on application of Law of Large Numbers to reduce volatility.
- *Affordability*. Review elements in transaction costs to provide affordable insurance products.

Therefore, one possible scenario is an integrated universal information platform to reach the objective of availability providing a smooth transaction and data exchange environment, with portals receiving data from external sources (e.g., IoT, wearables and geo data). The data collected via this platform shall not be limited to the insured or insurable risks, it shall also cover the non-insurable risks. By doing this, the platform can also assist in research for assurability to check the potential improvement in risk financing arrangement by Law of Large Numbers. This will be essential for new product design to enhance both assurability and affordability.

CONCLUSIONS

From definitions of insurance and purposes of entities in insurance, risk information and risk financing are identified as research background in this paper.

(1) In the exploration of risk information, we review the required underwriting information and clarify insurance ecosystem with three critical elements, risk, contract and portfolio. A universal platform with standard of data structure (e.g., EDI) is then proposed for smooth insurance operation as a new environment for ecosystem.

(2) In the exploration of risk financing, we apply Coase Theorem to explain why insurance transaction can or cannot be made based on the transaction cost considerations, and how Law of Large Numbers is affecting the entire industry. Observations are then used in the framework of InsurTech for the assessment of potential impact of new technologies.

From the above, the framework of InsurTech is defined as technologies to improve insurance business model regarding availability, affordability and assurability. Both evolutionary and revolutionary approaches are proposed for InsurTech development, which is expected to provide guidance for proper resource allocation for both improvements in current business model and as a roadmap for innovation of new models.

REFERENCES

[1] Agrawal, V., de Gantès, G., & Walker, P. (2014). Life Journey: Winning in the Life-Insurance Market. *McKinsey & Company*.

[2] Beath, C., Tarafdar, M., & Ross, J. (2018). OneBankAssure: customer intimacy through machine learning. In *International Conference on Information Systems (ICIS*), AIS Electronic Library, San Francisco, USA, Dec 13-16, 2018

[3] Borch, K. (1984). Equilibrium premiums in an insurance market. *Journal of Risk and Insurance*, 51(3), 468-476.

[4] Catlin, T., Lorenz, J. T., & Morrison, C. (2017). Insurers' Digital Reality—Fewer Premiums, More Competition. *McKinsey & Company*.

[5] Catlin, T., Lorenz, J. T., Nandan, J., Sharma, S., & Waschto, A. (2018). Insurance Beyond Digital: The Rise of Ecosystems and Platforms. *McKinsey & Company*.

[6] Chester, A., Clarke, R., & Libarikian, A. (2016). Transforming into an Analytics-Driven Insurance Carrier. *McKinsey & Company*.

[7] Coase, R. H. (1937). The nature of the firm. *Economica*, New Series, *4*(16), 386-405. https://onlinelibrary.wiley.com/doi/epdf/10.1111/j.1468-0335.1937.tb00002.x

[8] Collins, R. (2018). Chapter 22 - Insurance in China, In Sabine L. B. VanderLinden, Shân M. Millie, Nicole Anderson, & Susanne Chishti, *The InsurTech Book: The Insurance Technology Handbook for Investors Entrepreneurs and FinTech Visionaries*, Wiley, UK.

[9] Johansson, S., & Vogelgesang, U. (2016). Automating the insurance industry. *The McKinsey Quarterly*.

[10] Loebbecke, C., Lueneborg, L., & Niederle, D. (2018). Blockchain technology impacting the role of trust in transactions: Reflections in the case of trading diamonds. In *Twenty-Sixth European Conference on Information Systems (ECIS2018*), Portsmouth, UK, 2018.

[11] Onno Bloemers, J.H.F. Chapter 44 - The Future of Insurance – From Managing Policies to Managing Risks, In Sabine L. B. VanderLinden, Shân M. Millie, Nicole Anderson, & Susanne Chishti, *The InsurTech Book: The Insurance Technology Handbook for Investors Entrepreneurs and FinTech Visionaries*, Wiley, UK.

[12] Passler, K.H. Chapter 6 - "Real" InsurTechStartups do it differently! In Sabine L. B. VanderLinden, Shân M. Millie, Nicole Anderson, & Susanne Chishti, *The InsurTech Book: The Insurance Technology Handbook for Investors Entrepreneurs and FinTech Visionaries*, Wiley, UK.

[13] Pearson, T (2019). Markets are Eating the World. https://taylorpearson.me/markets-are-eating-the-world-book/

[14] Rodríguez Cardona, D., Werth, O., Schönborn, S., & Breitner, M. H. (2019). A mixed methods analysis of the adoption and diffusion of chatbot technology in the German insurance sector. In *Twenty-fifth Americas Conference on Information Systems*, Adoption and Diffusion of Information Technology (SIGADIT).

[15] Wilson, Jay D. (2017) *Creating Strategic Value through Financial Technology* (Chapter 8 - InsurTech and the future of insurance), John Wiley & Sons, Inc.

[16] Yan, T. C., Schulte, P., & Chuen, D. L. K. (2018). InsurTech and FinTech: banking and insurance enablement. In *Handbook of Blockchain, Digital Finance, and Inclusion, Volume 1* (pp. 249-281). Academic Press.

[17] Yu, J. & Yen, B. (2018). A Cryptocurrency based Insurance Model. In *Proceedings of The 18th International Conference on Electronic Business (ICEB)*, Guilin, China, December 2-6.

[18] Yu, J., & Yen, B. P. (2018). Basic Risk Information Component (BRIC) and Insurance. In *Cross Strait Conference of Information Management Development and Strategy*. Hong Kong.

[19] Zhong An Technology (2018). China Reinsurance Group, Hannover Reinsurance Shanghai Branch. General Reinsurance Shanghai Branch - White Paper for Reinsurance Blockchain. https://www.reinsurancene.ws/hannover-re-joins-new-chinese-reinsurance-blockchain-initiative/