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MASTER´S FINAL WORK

INTERNSHIP REPORT

A BUSINESS PROCESS MODEL FOR SOLVENCY II USING EVENT-DRIVEN PROCESS CHAINS

BY JOÃO MIGUEL CARVALHO DA SILVA

ISEG

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Abstract

Solvency II brought some challenging requirements for insurance companies concerning the amount and periodicity of the reported information. Hence, it is difficult for an insurer to comply with such requirements without mapping and organizing the flow of information regarding the process of Solvency II. With reference to this subject, the Portuguese insurance companies are no different.

This report follows an internship at CA Seguros, a medium sized Portuguese insurance company. The main objective of this internship was to map and document the whole process of Information Management for quantitative reporting (Pillars 1 and 3) on Solvency II. Hence, the possibility of mapping a company's Solvency II process with a business process model using Event-driven Process Chains is assessed.

Following this line of thought, literature review on Solvency II, Business Process Management, Business Process Modeling and Event-driven Process Chains is presented. A methodology based on process documentation in line with the Business Process Modeling approach and the Event-driven Process Chains modeling technique was developed.

Results show that the business process model was effective, providing a viable collection of documentation within the Event-driven Process Chains limitations.

Keywords: Solvency II, Business Process Management, Business Process Modeling, Business Process Model, Even-driven Process Chains.

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Resumo

A directiva Solvência II trouxe alguns requisitos desafiantes para as companhias de seguros quanto ao montante e periodicidade da informação relatada. Com isto, é difícil para uma seguradora cumprir com tais requisitos sem mapear e organizar o fluxo de informação respeitante ao processo de Solvência II. Neste sentido, as companhias de seguros portuguesas não são excepção.

Este relatório decorre de um estágio na CA Seguros, uma companhia de seguros portuguesa. O principal objectivo deste estágio foi mapear e documentar todo o processo de Gestão de Informação para reporte quantitativo (Pilares 1 e 3) respeitante ao processo de Solvência II. Para tal, é avaliada a possibilidade de mapear o processo de Solvência II de uma empresa com um modelo de processos de negócio utilizando Cadeias de Processo Conduzidas por Eventos.

Seguindo essa linha de pensamento, é apresentada a revisão de literatura sobre Solvência II, Gestão de Processos de Negócio, Modelação de Processos de Negócio e Cadeias de Processos Conduzida por Eventos. Foi desenvolvida uma metodologia baseada na documentação de processos de acordo com a abordagem de Modelação de Processos de Negócio e a técnica de modelação Cadeias de Processo Conduzidas por Eventos.

Os resultados mostraram que o modelo de processos de negócio foi eficaz, fornecendo uma colecção de documentação viável dentro das limitações das Cadeias de Processo Conduzidas por Eventos.

Palavras-chave: Solvência II, Gestão de Processos de Negócio, Modelação de Processos de Negócio, Modelo de Processos de Negócio, Cadeias de Processo Conduzidas por Eventos.

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Abbreviations

BPM - Business Process Management

BPm - Business Process Modeling

CEIOPS - Committee of Insurance and Occupational Pensions Regulator

EIOPA - European Insurance and Occupational Pensions Authority

EPC - Event-driven Process Chain

ORSA - Own Risk Solvency Assessment

ITS - Implementing Technical Standards

RTS - Regulatory Technical Standards

SCR - Solvency Capital Requirement

MCR - Minimal Capital Requirement

SFCR - Solvency and Financial Condition Report

ARIS - Architecture of Integrated Information Systems

SOP - Standard Operating Procedures

QRT - Quantitative Reporting Templates

RSR - Regular Supervisory Report

1. Introduction

In pursuance of both policyholders' protection and financial markets' stability, insurance companies should have enough solvency margin to meet their undertaking risks. Hence, to ensure this would happen and in response to the increasingly complex financial markets, the European Commission established the Committee of Insurance and Occupational Pensions Regulator (CEIOPS). This committee developed a solvency regulation framework (Solvency I) in order to revise and update the European solvency regime.

The Solvency I directive brought few changes to the capital requirement standards applied in the 1970s. It mainly focused on a book value approach with simplistic capital requirements and no provision for risk review. This directive provided the first set of rules for minimum capital requirements (Eling et al, 2007). The need to increase the levels of both consumer protection and market integration originated the creation of the Solvency II directive (Institute and Faculty of Actuaries, 2016). This framework was created by the European Insurance and Occupational Pensions Authority (EIOPA) which replaced CEIOPS. Solvency II followed a more risk based approach which led to a better tailoring of the minimum amount of capital required to cover undertaking risks and protect policyholders.

The introduction of the Solvency II regulatory framework brought some considerable challenges to Insurance companies, namely on reporting requirements. The reporting period changed from annual to quarterly which exerted immense pressure on the companies' day-to-day businesses. This new requirement brought to light the importance of having the flow of information regarding Solvency II mapped and optimized. In order to do so, Solvency II needs to be assessed as company's process and

analysed holistically. Despite being a mandatory process, it is of great value to a company since it has a focus on risk management which drives insurers to make a better assessment of their undertaking risk. According to Scheer and Nüttgens (2000), a business process is any procedure which can be viewed holistically and has enough relevance to add value to a company. Hence, a company's Solvency II process may be treated as a business process.

In this context, Business Process Management (BPM) seems to be a feasible tool since its set of activities, arranged in a lifecycle, enables the management of a business process. Therefore, it provides supportive conditions for both assessments of regulation compliance and auditing of a related business process. One of the benefits of performing BPM is the capability of using business process models to map a process. A graphical representation may be a good approach to facilitate both the analysis and comprehension of the business process model by its stakeholders. This graphical representation is done using the approach of Business Process Modeling (BPm) which is part of a BPM lifecycle (Mendling, 2008). This goes in line with the possibility of BPM being a feasible solution to map the flow of information of a company's Solvency II process.

Performing a BPm process involves a modeling technique used to design the model and a modeling tool to implement it. This requires personnel to perform the model's design and the purchase of the modeling tool if the company does not have one. Hence, it is important that a business process model is both properly analysed and designed since it has an economical risk associated. Disregarding relevant aspects of the related business process' purpose or making either semantic or syntax mistakes may turn out to be quite expensive. In the interest of guarantying that the model is properly analysed

and designed, the Guidelines of Modeling framework (Becker et al., 2000) can be used. In addition to the guidelines, this framework also gives some recommendations on specific modeling techniques such as the Event-driven Process Chain (EPC). The business process models resulting from this technique are used in some of the leading modeling tools, such as the ARIS Toolset.

This report follows an internship at CA Seguros, a medium sized Portuguese insurance company. The company's main objective was to have the flow of information regarding its Solvency II process, mapped and documented. To give response to the identified needs, the following research project is presented. **A Business Process Model for Solvency II Using Event-driven Process Chains.**

The remainder of this report is structured as follows. The internship's framework is presented in Chapter 2. Chapter 3 addresses relevant literature review on Solvency II, Business Process Management, Business Process Modeling and Event-driven Process Chains. Furthermore, a solution for the research project and its consequent results are assessed in Chapter 4. Finally, Chapter 5 presents a brief conclusion of this report.

2. Internship's framework

This chapter gives a description of both Grupo Crédito Agrícola and CA Seguros. Moreover, it addresses the internship's scheduled program and performed activities.

2.1. *The Group*

Grupo Crédito Agrícola is a financial group, member of the Portuguese Association of Banks. It operates on a national scope, offering a vastly diversified array of financial services for all segments of both banking and insurance areas. Apart from the bigger cities such as Lisbon, Oporto and Braga, it has a noticeable presence in the national market. According to Crédito Agrícola (2017b), this acknowledged centenary cooperative institution is composed by:

- A Head Bank responsible for guiding, supervising and orienting the activity of its 82 Associated Mutual Agricultural Credit Banks;
- Eight companies directly or indirectly affiliated with the Head Bank;
- The National Federation of Mutual Agricultural Credit Banks entitled to defend the best interests of the Associated Banks and represent them on different levels (Crédito Agrícola, 2015b).

In addition to being a Group which operates on a national scope, it has an international presence in Europe and Africa through some infrastructures and equity participations. In extension to this international presence, the Group is also a member of the European Association of Co-operative Banks, International Confederation for Agricultural Credit and the International Raiffeisen Union.

The Group's mission is to be the catalysing force behind the development of local communities (Crédito Agrícola, 2015a). Through a relationship with its clients based on

proximity, helping them giving response to their ambitions and financial projects. Its strategy pursues the reinvestment of profits generated by each Associated Bank in their region of activity and financing the locals' projects through application of deposits. Driven by this line of thought, it was able to contribute to the development of the regions it operates in, due to its deep knowledge on the regions' both social and economic fabric allied to the well specified business segments. Herewith, according to the study "Top 1000 World Banks" performed by the British magazine The Banker, Crédito Agrícola is the third most solid bank operating in Portugal (Crédito Agrícola, 2015a).

For the purpose of this project, the segment of interest is Protection, which can be split into two branches: non-life and life insurance (Crédito Agrícola, 2016). The objective of the project addresses to the non-life branch. The Group operates via an indirectly affiliated insurance company through *Bancassurance* with the Head Bank and Associated Mutual Agricultural Credit Banks, as described in the next sub-chapter.

2.2. CA Seguros

The Group founded Crédito Agrícola Seguros – Companhia de Seguros de Ramos Reais, S.A in 1994. The mission is to guarantee the safety and protection of its clients, through a set of insurance solutions to individuals, businessmen and companies adequate to their specific needs (Crédito Agrícola, 2017a). It insures more than 340 thousand clients, with more than 600 thousand policies in force, through its more than 700 agencies (CA Seguros, 2015). The Company's philosophy is intrinsic to the Group's. Not only it values a relationship of proximity with all its clients, but with the Associated Mutual Agricultural Credit Banks and Head Bank as well. This enables CA Seguros to perform a careful due diligence on the regions it operates in, so that it can

arrange and select the best solutions for the specific needs of each region and type of client. By making good use of the previous procedures, CA Seguros has been named the best non-life insurance company of its segment for the 6th time in the last 9 years (CA Seguros, 2015).

The Company's shareholder structure comprises three entities: Crédito Agrícola Seguros e Pensões, SGPS – 97.369%; Confagri – 2.604% and Associated Mutual Agricultural Credit Banks – 0.027%. Its corporate governance structure, based on a dualistic model (Crédito Agrícola, 2015a), is composed by: Executive and General and Supervisory Boards; Remuneration and Financial Matters Committees; General Assembly and Statutory Auditor. Furthermore, the Company has implemented Quality and Environmental Management Systems which are certified in accordance with the ISO 9001:2008 and ISO 14001:2012, respectively. The organizational structure is divided into Offices and Areas, established and designed to promote the quality of service to all clients. These Offices are responsible for rendering both technical advisement and specialized services. On the other hand, the Areas are coherently organized with the Company's objectives. Thus, they are articulated through a set of responsibilities and both pre-determined and permanent functions.

By operating exclusively via *Bancassurance*[1], the company's strategy aligns itself with the Group's. It sells the products to the Bank's client base, hence, mainly to individuals and has a small presence in the two major cities' markets – Lisbon and Oporto. CA Seguros focuses its activity in all the technical non-life insurance branches excluding Aircraft, Credit and Suretyship. It is also a significant market player in the crop insurance branch which represents 6.9% of the gross written premiums.

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[1] Partnership between a bank and an insurance company where the bank allows the insurer to sell its products to their client base.

Traditionally, the ones with the highest percentage of premiums volume from the Company's total production are the automobile, accidents at work, personal accidents and homeowners insurances with 28%, 15%, 12.9% and 12.6% (CA Seguros, 2015), respectively. The Company is part of an industry going through a deep regulatory restructuration. This new regulation is introduced in chapter 3.

2.3. Scheduled Program

The internship took place in CA Seguros and lasted for 6 months from February 1st to July 31th. The theme focused on Information Management under Solvency II. My assigned supervisor was Miguel Henriques, head of the Company's Information Management Office. The program had the following schedule:

- February and March – Insurance general theory (training through an e-learning platform) and Risk Management Office (Solvency II contextualization);
- 1st week of April – Quality and Internal Control Office (Operational Risk);
- 2nd week of April – Financial Area (Market Risk);
- 3rd week of April – Actuarial Office (Underwriting Risk);
- From the 4th week of April until July 31th – Information Management Office.

When I started the Internship, my knowledge on the Insurance Business came merely from a consumer's standpoint. Taking this into account, I needed to have some theoretical training on the business matter. To mitigate this need, the Company offered me the opportunity to take an E-learning course on insurance theory developed by the Portuguese Insurance Association. By the time I finished it, I had a good understanding on how the insurance world works, with an emphasis on the non-life branch.

Following the previous course, the head of the Risk Management Office gave me insights on the Solvency II subject. I learned about the reasoning behind this new regulatory tool which is intrinsic to the objective of this project. Moreover, these insights enabled me to understand how this directive was implemented and what it covered.

Subsequently to this introductory experience, the Company enabled me to spend some time with the heads' of the different departments. Firstly, I had the opportunity to speak with the head of the Quality and Internal Control Office. I got to know how this office was mainly responsible for Compliance and controlling the Operational Risk. This is done through a set of methodologies and activities stated in the Company's Operational Risk Policy. Moreover, it is also responsible for ensuring the quality within the Company's day-to-day business.

Unfortunately, it was not possible to follow the scheduled program for the second and third weeks of April, due to strict work related deadlines that both areas had to meet. Instead, the company provided me with the opportunity to physically stay in the Information Systems Area. Hence, I got to know how the company's systems are integrated and communicate with each other.

To conclude the program's schedule, I worked with the Information Management Office from the 4th week of April until July 31th. This Office is responsible for providing both structured data for the whole company and compliance related information. During this time period, I was able to understand how the company produces and organizes the information needed to fill the reported QRTs.

2.4. Performed activities

The first activity was the E-learning course on insurance theory developed by the Portuguese Insurance Association, as stated in the scheduled program. This course included chapters with theory and multiple choice tests on both the life and non-life insurance branches.

Succeeding the completion of the course, I started to collect literature on how to develop process documentation. This was necessary since I needed to come up with a documentation methodology (explained in 4.1 Documentation methodology) which would be presented to the Company's Solvency II team at the project's kick-off meeting. The development of the methodology and consequent preparation of the kick-off meeting was done in one month's period. After the meeting, I was able to start gathering inputs for the project with the people involved in the process and therefore prepare the documentation.

The gathering of the inputs was achieved through interviews with the process masters and other members of the Company's Solvency II Team. The gathered inputs were used in all the produced documentation. This activity was done iteratively since every piece of documentation prepared needed to be validated by the process masters and sometimes redone.

The preparation of the documentation consisted on producing the workflows in Excel and both the Standard Operating Procedures and QRT dictionary in Word format. The activities of gathering inputs and preparing the required documentation took about three and a half months to finish. During this time period, I also did some tasks which were directly related with Solvency II but not with the project itself. The most important task

done in parallel with the project was to help my supervisor verify and guarantee that the values of the QRTs which had to be reported were correct.

Now that the internship's framework has been introduced, it is important to have a theoretical approach on the themes addressed in the project.

3. Literature review & Research project

This chapter assesses some literature review concerning the subjects of Solvency II, Business Process Management, Business Process Modeling and Event –driven Process Chains. Moreover, the idea for the research project is introduced.

3.1. Solvency II

Solvency II consists on a new, harmonized regulatory framework for the European insurance industry, which entered into force on January 1st, 2016. This legal instrument created by the European Insurance and Occupational Pensions Authority (EIOPA), is binding in 31 European Economic Area (EAA) countries (the 28 EU member states plus Norway, Iceland and Lichtenstein). It also has an impact outside Europe, namely on external insurance groups. If their national supervisory regimes are considered equivalent, they might enter more easily on the European market.

In contrast with Solvency I which adopted a book value approach, Solvency II follows a more economic risk-based approach. Insurers need to have enough capital to cover the worst expected losses over a year, with 99.5% confidence. As a result, each insurer started measuring assets and liabilities by their market value. This led to a better tailoring of the minimum amount of capital required to cover their risks and protect policyholders.

The reasoning behind the implementation of Solvency II can be traced to previous literature. Taylor (2009) stated that the problems in financial markets which led to the crisis were mainly due to counterparty risk rather than liquidity. With this, according to Gutsche (2011), the latest financial crisis has shown that companies' strength should be assessed as a result of understanding the risks they undertake, rather than the size of their balance sheets. Hence, the quality of both the transparency and credibility of companies' reporting was of major importance.

As stated in Leuz and Wysocki (2015), events like a financial crisis often lead to reforms in reporting and disclosure regulation. In the aftermath of these events, policy makers and regulators tend to make efforts to improve the quality of corporate transparency. Financial statements should not be opaque or difficult to be interpreted, since their main goal is to allow its users to make educated decisions (Dickinson and Liedtke, 2004). Being cognisant of the importance of a higher quality reporting, EIOPA proposed to implement the Solvency II regulatory framework.

This new harmonized framework has three main objectives:

- According to Buckham, Wahl and Rose (2010), the primary objective is embedded in the improvement of consumer protection. It intends to strengthen policyholders' protection in the EU through higher minimum capital requirements and early warning of solvency deterioration levels;

- The second one is to develop a modernized supervision (Lloyd's, 2017). Hence, it will shift the supervisor's focus from compliance monitoring to evaluating companies' risk profile and both risk management and governance systems;

- The third and last main objective is the EU insurance market integration (Lloyd's, 2017). A single European insurance market ensures the application of this regulation in all Member States plus Norway, Iceland and Lichtenstein.

According to O'Donovan (2014), the legislative structure is divided into the following four levels:

- Level 1 comprises the Directive 2009/138/EC of the European Parliament and Council of 25 November 2009. This legal text determines the core values and essential framework principles;

- Level 2 includes the Commission Delegated Regulation (EU) 2015/35 of 10 October 2014. Implementing Technical Standards (ITS) and Regulatory Technical Standards (RTS) are also included in this level. These are the implementing measures insurers must meet;

- Level 3 corresponds to Guidelines created by EIOPA, which are used to ensure consistent implementation and application of the Directive;

- Level 4 relates to post-implementation enforcement. The European Commission is responsible for member states' compliance with the legislation.

As a way of grouping Solvency II requirements, EIOPA defined three pillars:

- Pillar 1 covers all the quantitative requirements ensuring companies have an adequate amount of risk-based capital (KPMG, 2011). It focuses on the computation of the Solvency Capital Requirement (SCR), Minimal Capital

Requirement (MCR). These two capitals may be computed through a Standard Formula or an Internal Model;

- Pillar 2 focuses on all the qualitative requirements. Thus, it covers the governance system, which includes the risk management and compliance systems. Furthermore, the supervisory review process and Own Risk Solvency Assessment (ORSA) are in this Pillar's scope as well (KPMG, 2011);

- Pillar 3 addresses transparency and market discipline through public disclosure and reporting requirements (ASF, 2017). Hence, stakeholders have access to more up-to-date information and a better representation of companies' financial positions.

Moreover, the proportionality principle is introduced, in respect to the requirements concerning risk calculations and report of necessary information (Bonsón et al., 2010). Thus, requirements' strictness is assessed according to a company's size.

Nurturing convergence and transparency of supervisory activity in all member states, is one of the greatest challenges of Pillar 3 (Gutiérrez Cordero, 2017). This Pillar consists of public disclosure and supervisory reporting. According to EIOPA (2015), the aim of an enhanced public disclosure is to improve market participant's abilities to evaluate the companies' solvency and financial conditions.

So that this may be achieved, EIOPA defined two founding principles of disclosure: Transparency and Market discipline (EIOPA, 2015). The first one is a cornerstone of the Solvency II regime (EIOPA, 2016). It has the objective of promoting efficiency and enabling companies to have credible comparable information when disclosing. The second one focuses on the relevance and clarity of disclosed information. Addressing

these two principles responsibly will generate benefits, such as more stable financial markets and an easier identification of market failures (EIOPA, 2015).

The object of public disclosure is the Solvency and Financial Condition Report (SFCR). This report is disclosed on an annual basis and incorporates the principle of proportionality (EIOPA, 2015). It gives qualitative and quantitative information on the topics shown in the figure below:
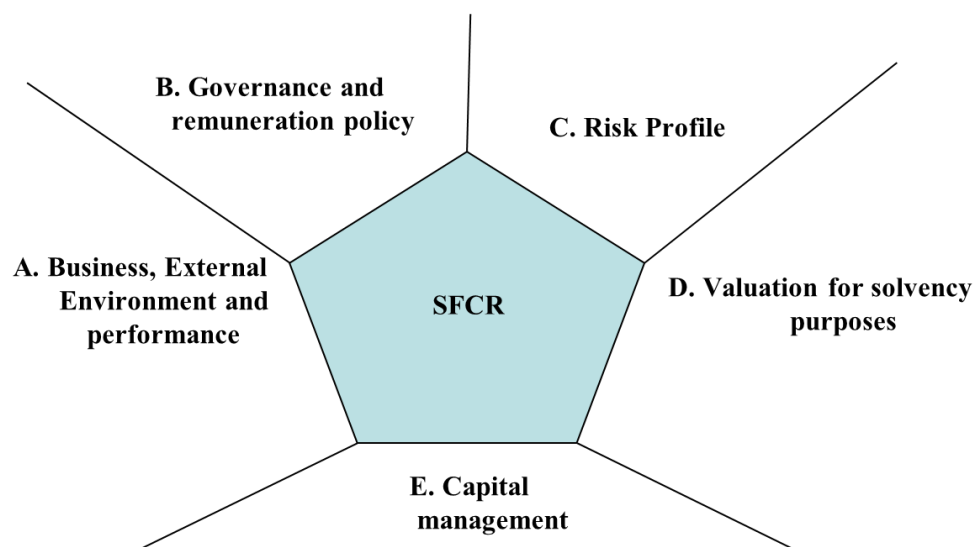

Figure 1 - Structure of Solvency and Financial Condition Report (SFCR) adapted from EIOPA (2011)

Supervisory reporting comprises the same information disclosed to the public, with a higher level of both frequency and detail (IVASS, 2016). This kind of reporting uses confidential and more detailed information than public disclosure to achieve its two main objectives: Micro-supervision and Macro-supervision (EIOPA, 2011). According to IVASS, this information is given to the supervisors through the following three reports:

• Regular Supervisory Report (RSR) which is highly detailed, with both qualitative information and the same structure of the SFCR;

- Quantitative Reporting Templates (QRT) with core information;

- ORSA which assesses the adequacy of a company's risk management, as well as its current and expected solvency condition under normal and severe stress scenarios.

Apart from the QRT which is disclosed both quarterly and annually, the other two reports are disclosed to the supervisors on an annual basis. In addition to the previous reports, companies must inform the competent supervisors immediately after a predefined event[2]. Companies deliver reports using the accepted harmonised templates for all member states, with application of the proportionality principle.

Solvency II is a real challenge for all parties involved. According to the framework's Directive, each member state needs to make sure supervisors have the power to guarantee that insurance companies comply with its requirements. Amongst these requirements, one is the need to prepare documentation on their manner of exercise of the options stipulated in the Directive. This documentation might have to be on both quantitative and qualitative practices. (EC, 2009). Hence, the regulatory framework pressures companies to better understand their method of operation and align it with compliance requirements (Fischer et al., 2015). This may be achieved through a good mapping and documentation of the whole Solvency II process.

In order to perform such task, BPM might be a suitable approach through its capability of using Business Process Models to map a process. Moreover, according to Ko (2009), BPM provides favourable conditions for both assessments of regulation compliance and auditing.

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[2] Event which might alter the risk profile of a company.

The next chapter will address BPM and its association with the attempt of optimizing the Solvency II process.

3.2. Business Process Management

The regulatory framework has a focus on risk management processes which drives insurers to make a better assessment of their undertaking risks. In practice, it is the catalyst for the design of risk modules capable of appraising operative risk mitigation strategies and carrying out risk-based performance measurements (Liebwein, 2006)**.** All in all, Solvency II process may not be part of an insurance company's core business but it is of great value to one.

According to Scheer and Nüttgens (2000), a business process is any procedure viewed holistically, endowed of enough relevance for adding value to an organization. Considering that an insurer needs to assess all the three pillars of Solvency II and that by doing so it will create value, the Solvency II process may be defined as a business process.

BPM is the set of activities performed in order to manage a related business process (Mendling, 2008). With this practice, the key activities of a process are managed and consistently improved, leading to higher quality outputs (Zairi, 1997).

Mendling (2008) stated that activities related with the management of business processes can be organized within a lifecycle. The figure below presents a possible BPM lifecycle:
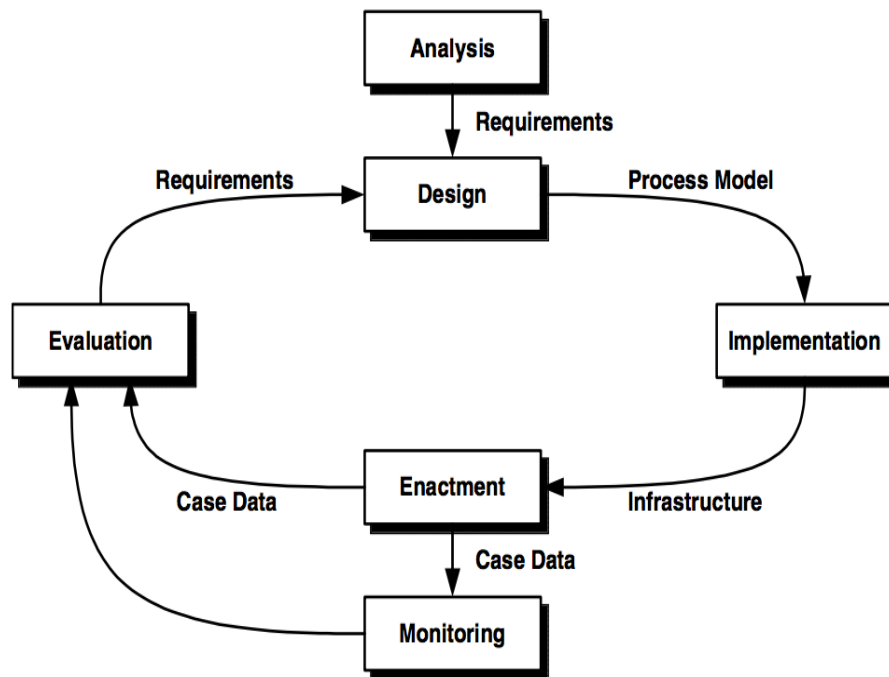
Figure 2 - Business Process Management lifecycle (Mendling, 2008)

This lifecycle has six activities that are related to each other: Design, Analysis, Implementation, Enactment, Monitoring and Evaluation. As shown in Figure 2, the activities have logical dependencies although they do not imply a rigorous chronological order of execution.

As stated in Weske (2012), the basis of BPM is the accurate representation of business processes with their activities and execution constraints between them. Figure 3 shows an information modeling process which allows an accurate representation of business processes:
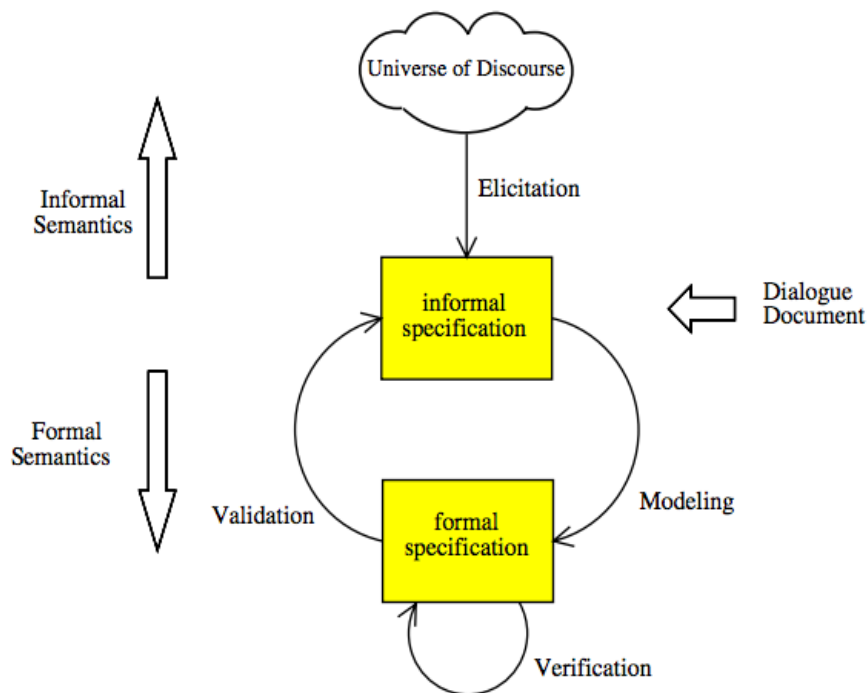
Figure 3 - Information modeling process (Frederiks and Van der Weide, 2006)

It enables the premature detection of potential errors which saves both time and money. Hence, Design and Analysis are the most important activities in a business process management life cycle. These two activities serve as a framework for Business Process Modeling (Mendling, 2008).

3.3. Business Process Modeling

The approach of graphically displaying business processes rose as a relevant domain of conceptual modelling (Indulska et al., 2009). Moreover, graphical representations facilitate process comprehension and communication between its different stakeholders (Weske, 2012). Mendling (2008) proposes a BPm process composed by eight steps and two main activities:
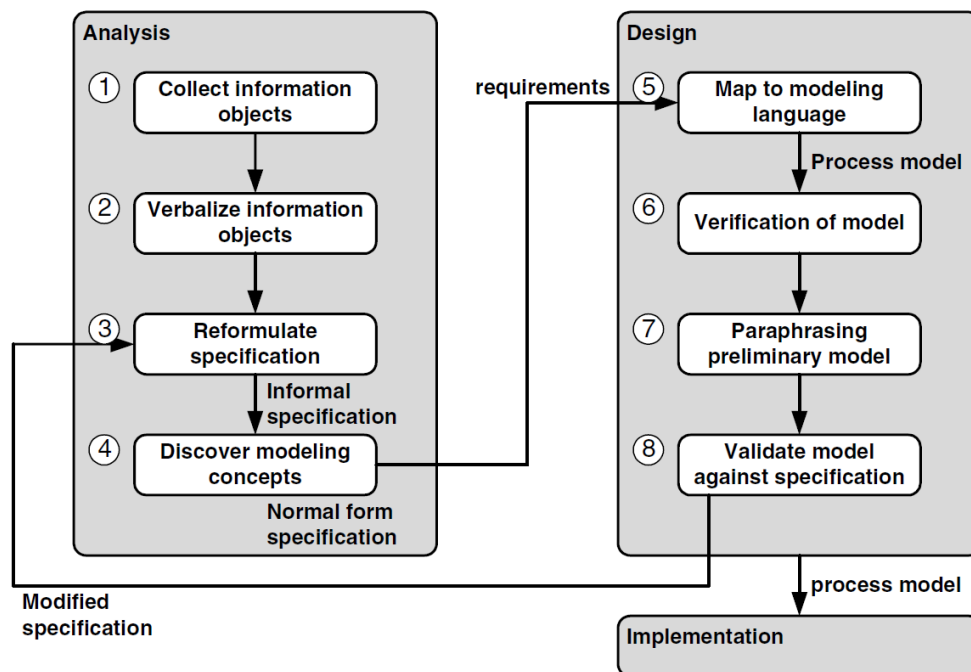
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Figure 4 - Business process modeling process (Mendling, 2008)

The process begins with collecting information objects relevant for the business process' intended purpose. This can be done by interviewing people with expert knowledge about the business process (Georgakopoulos and Tsalgatidou, 1998). Once there is enough information, it may be both verbalised and arranged into an informal business process specification. It is then formalised through a particular business process modeling technique resulting in a business process model. Once the model's design is complete, one may come to the conclusion that is does not fulfil its purpose (Becker et al., 2000). The insufficiency or even incorrectness may result from formal errors such as notation mistakes or from disregarding relevant aspects of the process. Hence, after the model is designed it needs to be both verified for formal correctness and validated addressing its consistency with the produced specification. In order to guarantee the quality of a BPm process, the Guidelines of Modeling (GoM) framework may be used.

This framework is composed by six principles (Becker et al., 2000):

- Correctness determines that a model must be both syntactically and semantically correct. A model is syntactically correct if it is consistent with its meta model and semantically correct if it is consistent with the perception of the real world;

- Relevance postulates that the model only includes relevant objects of the universe of discourse. Therefore, a relevant modeling technique must be used;

- Economic efficiency evaluates the trade-off between benefits and costs of putting the other guidelines into practice. This criterion supports the usage of an appropriate modeling tool;

- Clarity requires that the model should follow some layout conventions in order to be understood by the model user;

- Comparability claims the consistent use of a set of guidelines within a modeling project;

- Systematic design assumes well-defined relationships between models in different views.

The first three principles (correctness, relevance and economic efficiency) are necessary prerequisites for the quality of the model, whereas the other three are optional (Mendling, 2008). In addition to the previous six general guidelines, this framework has recommendations for specific modeling techniques such as Event-driven Process Chains (Becker et al., 2000).

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3.4. Event-driven Process Chain

The EPC is a business process modeling language created in 1992 at the Institute for Information Systems, University of Saarland, Germany (Scheer et al., 2005). It is the modeling notation used in the Architecture of Integrated Information Systems (ARIS) which is mostly used by companies whose processes are managed with the modeling tool, ARIS Toolset. EPC[3] represents the control flow concerning temporal and logical dependencies of activities in a business process (Dongen et al., 2013). It can use four interrelated types of elements as notation in order to recreate the representation of a business process. They are linked with each other through control flow arcs so that the EPC may be simple, directed, coherent and antisymmetric. These elements are the function, event, connector and process interface types.

The first and second ones capture the activities and both the pre-/post-conditions of functions of a certain business process, respectively (Dongen et al., 2013). The third one divides itself into three kinds of connectors including AND (symbol ∧), OR (symbol ∨) and XOR (symbol ×). These connectors either have multiple incoming and one outgoing control flow arcs or vice versa (Mendling, 2008). The fourth type is a syntax element which links two consecutive EPCs. At the end of the first EPC, a process interface element links with the beginning of the second EPC. This way, a process can be linked to its sub-process. Figure 5 presents an example for EPC:

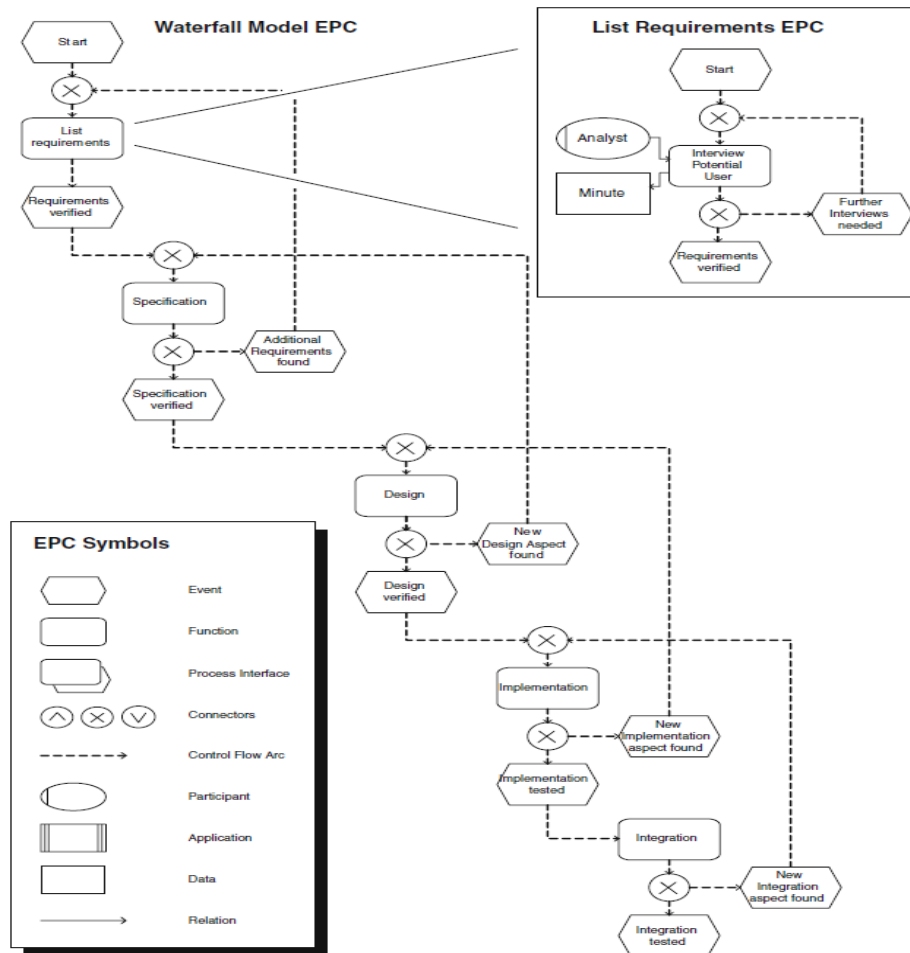[3] A formal definition for an EPC is given in the appendix.

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Figure 5 - Example for an EPC (Mendling and Nüttgens, 2006)

According to Dongen et al. (2013), a formal syntactically correct EPC cannot have two consecutive events or functions. They must alternate on each path throughout the EPC, either directly or indirectly if they are linked via one or more connectors. Regarding semantics, a determined EPC may be composed by AND-/OR-/XOR-splits/-joins (Dongen et al., 2013). While the AND-split triggers all subsequent branches in eligibility, the AND-join waits for the completion of all incoming branches before propagating control to the next EPC element. The OR-split activates one, two or all subsequent branches in eligibility and the OR-join coordinates all active incoming branches. The XOR-split determines a choice between one of several alternative branches while the XOR-join brings alternative branches together. OR-/XOR-splits are

not allowed after an event as the trigger conditions do not become clear in the model. In conclusion, since the ARIS Toolset provides for the entire documentation of a company's business processes (Georgakopoulos and Tsalgatidou, 1998) using EPCs as the modeling technique, might be a viable solution to document a Solvency II process.

Now that the research project is in line with the literature review, it is possible to propose and formulate a solution. This is addressed in the following chapter.

4. Proposed solution for the research project

This chapter assesses a proposed solution for the research project (mentioned in 1. Introduction) in a business-like case at CA Seguros. The solution consists on creating a business process model through the application of a documentation methodology in line with both the BPm approach and EPC modeling technique. The results of applying the methodology are also presented. Finally, a business case/company research for Solvency II and/or BPm is given.

4.1. Documentation methodology

The objective is to mitigate three needs identified by the Company:

- Document the Solvency II process so that it becomes auditable. With this, competent supervisory authorities can issue their opinion on the process' quality, consistency and reliability;

- Make the process comprehensible and free of possible doubts on its information flow. Hence, every actor that directly or indirectly participates on the process may fully understand it;

- Mitigate, as much as possible, the operational risks associated with the process.

The required documentation assesses the whole process of Information Management for quantitative reporting (Pillars 1 and 3) on Solvency II at CA Seguros. Considering that the Company already possesses a Business Process Modelling tool named ARIS Business Process Analysis, it will be used for the model's implementation. Therefore, it is possible to make the documentation available to the process' stakeholders. This tool allows the designing of a model with Petri nets[4] which, unlike the EPCs, would enable to check the model for completeness and consistency (Van der Aalst, 1999). However, since the Company's uses EPCs to design its processes onto the modeling tool, the same modeling technique is applied in this case.

In order to compose this documentation and taking into consideration both the BPm process shown in Figure 4 and the process documentation guidelines presented by Ungan (2006), the following methodology is used. The level of detail applied must be adequate to both the Company's reality and purpose behind the process' documentation (Ungan, 2006). Since CA Seguros is a medium sized company and the documentation's objective is to describe the process, the micro level is applied. According to Ungan (2006), the chosen procedure corresponds to the second level of detail. The process is described and systematised in a macro perspective, as well as the inherent sub-processes in a micro perspective. Thus, it is possible to understand and analyse all details throughout the process.

The requirements' gathering and consequent inputs' collection necessary for the process's description/systemization is done through interviews (Ungan, 2006). The process relies heavily on know-how knowledge, which according to Ungan (2006), has

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[4] For additional information, please refer to The application of Petri nets to workflow management. Journal of circuits, systems, and computers, 8(01), 21-66 (Van der Aalst, 1998).

a tacit and not explicit source. Thereupon, it is difficult to be articulated since it is experience-based knowledge which is subjective to each individual. So that the requirements gathering result in a reliable cluster of inputs, it is essential for the actors to represent themselves in teams (Ungan, 2006). Each team has a process master which is the actor with the most knowledge on the process. The team members must reach a consensus concerning the inputs' quality. At the end of each gathering, the process master proceeds with the checkout, confirming the quality of the collected inputs. The requirements' gathering is done iteratively since the specifications might be reformulated. When gathering requirements, it is necessary to take into consideration the article 103.º from the Portuguese Legal Regime of Access and Exercise of the Insurance and Reinsurance Activity which refers to the importance of data quality.

The purpose of the process is the preparation and consequent disclosure of the different reports required by the competent supervisory authority. The preparation strives for the organization, reliability and quality of the information flow. The reporting focuses on the total transparency and credibility of the reported elements. The inputs for the reports are the elements used to calculate the following risks:

- Non-life underwriting;
- Health underwriting;
- Market;
- Counterparty default;
- Operational;
- Intangible assets.

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Finally, the actors are:[5]

- Financial Department;

- Information Systems Department;

- Underwriting Department;

- Actuarial Department;

- Risk Management Office;

- Information Management Office.

The process' perimeter extends from collecting information in the databases to informing the Council of Executive Administration of the process' conclusion.

The performance measures applied in this documentation are the effectiveness, efficiency and adaptability. According to Ungan (2006), effectiveness determines how well the process can achieve its objective. Moreover, efficiency measures the amount of effort and resources which are used for the process to reach its goal. Additionally, adaptability determines how fast the process can adapt to a new reality.

In pursuance of a solution to the identified needs, taking into consideration the proportionality principle (article 65.º, n.º 5, article 94.º, n.º 2 and article 309.º, n.º 3, from the Portuguese Legal Regime of Access and Exercise of the Insurance and Reinsurance Activity[6]) and the modeling tool already in the Company's possession, the business process model is designed using:

- EPCs systematising the whole process' information flow. Hence, all functions, events and actors subject to the process are documented. Furthermore, one value

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[5] Área Financeira (AF); Área de Sistemas de Informação (ASI); Área de Subscrição (ASUBS); Gabinete de Actuariado (GA); Gabinete de Gestão de Risco (GGR); Gabinete de Gestão de Informação (GGI) (Author's translation).

[6] Regime Jurídico do Acesso e Exercício da Atividade Seguradora e Resseguradora - RJASR (Author's translation).

chain has to be designed as well, in order to organize the process in the Company's modeling tool;

- Standard Operating Procedures (SOP) supporting the flowcharts and describing the sub-processes so that they may be analysed and easily comprehended. With this, associated operational risks are either partially or totally mitigated. These are adequately descriptive about the whole process' information flow;

As a complement to the model, a QRT dictionary clearing up any doubts on the technical vocabulary applied in the templates' filling is also created. These 3 types of documentation are grouped in a master document to facilitate the navigation between them.

All EPCs and SOPs composing the business process model as well as the QRT dictionary are subject to validation against the specifications by the process masters.

4.2. Results

With the application of the methodology (presented in 4.1 Documentation methodology), the following results are obtained:

Table I

Results obtained by applying the documentation methodology

	Documentation developed
EPCs	27 EPCs + 1 value chain
SOPs	26 sub-processes described
QRT dictionary	39 QRTs documented

Out of the 27 EPCs designed to compose the model, one corresponds to the macro level view of the whole process of Information Management for quantitative reporting (Pillars 1 and 3) on Solvency II. The remaining 26 EPCs correspond to each one of the sub-processes. All these EPCs are available in the link shown in Appendix C. Throughout the process of designing the EPCs, the rules presented by Dongen et al. (2013) regarding syntax and semantics are taken into consideration. Hence, it is possible to guarantee the correctness of both their syntax and semantics. All the 27 EPCs including the value chain are validated against the specifications by the respective process masters.

Each one of the 26 SOPs produced corresponds to the respective sub-process. They are considered to be effective in describing the sub-process, by the actors taking part in it. These 26 SOPs are introduced in the respective sub-process flowcharts through a hyperlink and validated by the respective process masters.

As a complement to the model, the 39 documented QRTs composing the QRT dictionary correspond to each one of the QRTs filled and reported by the Company to the competent supervisory authorities, namely the Portuguese Insurance and Pension Funds Supervisory Authority and the European Central Bank. This dictionary is considered to be successful in providing an explanation to each of the QRTs filling method and was validated by actors responsible for the each filling.

All documentation respects the performance measures presented by Ungan (2006) (presented in 4.1 Documentation methodology). It is effective in mapping and documenting the process since, according to the process masters, it covers all the relevant aspects and details. It is efficient since it only covers what is relevant and it is possible to implement it in the modeling tool already in possession of the company.

Finally, it is possible to adapt it to a whole new reality without losing relevance since the modeling technique allows for changes as long as the semantics and syntax remain correct.

4.3. Business Case/Company research

This work may be useful when considering a business case for Solvency II and/or BPm since it can be either applied to other insurers, or in schools which have courses regarding these subjects.

With this, a business case/company research in presented in the Appendices (see Appendix B). The answer for this case is composed by a theoretical framework (Chapter 3) and a proposed solution (Chapter 4).

5. Conclusion and Future Research

The main purpose of this report is to address the viability of mapping and documenting a Solvency II process with a business process model using Event-driven Process Chains, hence giving response to the Company's needs.

The application of the methodology allows the development of a business process model using the following types of documentation: Event-driven Process Chains, which enables the mapping of the whole process of Information Management for quantitative reporting (Pillars 1 and 3) on Solvency II, including the sub-processes. A value chain organizing the process in the Company's modeling tool is developed as well. Standard Operating Procedures, which provides for a description of the sub-processes, mitigating either partially or totally, the associated operational risks. Finally, complementing the business process model, the methodology also allows the development of a QRT dictionary which clears up any doubts on the technical vocabulary applied in the templates' filling. With this, the results imply that it is viable for a company to map and document a Solvency II process with a business process model using Event-driven Process chains.

For future work, it would be interesting to map and document a Solvency II process with a business process model using EPCs mapped onto Petri Nets. Results could be used to assess efficiency and effectiveness of both methodologies.

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References

ASF (2017). Solvência II – Enquadramento [Online]. Available at http://www.asf.com.pt/NR/exeres/7BF5C5A6-9B7E-4516-B51F-727E24F69E8D.htm [accessed on: 2017-04-03].

Becker, J., Rosemann, M., & Von Uthmann, C. (2000). Guidelines of business process modeling. In *Business Process Management* (pp. 30-49). Springer Berlin Heidelberg.

Bonsón, E., Cortijo, V., Escobar, T., Flores, F., & Monreal, S. (2010). Solvency II and XBRL: new rules and technologies in insurance supervision. *Journal of Financial Regulation and Compliance*, *18*(2), 144-157.

Buckham, D., Wahl, J., & Rose, S. (2010). *Executive's guide to solvency II*. John Wiley & Sons.

CA Seguros (2015). Relatório e Contas 2015.

Crédito Agrícola (2016). Apresentação corporativa 2016.

Crédito Agrícola (2017a). CA Seguros [Online]. Available at: http://www.credito-agricola.pt/CAI/Institucional/EstruturadoGrupo/EmpresasParticipadas/CASeguros/ [accessed on: 2017-02-20].

Crédito Agrícola (2017b). Quem somos [Online]. Available at: http://www.credito-agricola.pt/CAI/Institucional/GrupoCA/QuemSomos/ [accessed on: 2017-02-17].

Crédito Agrícola (2015a). Relatório e Contas – Consolidado 2015.

Crédito Agrícola (2015b). Relatório de Sustentabilidade 2015.

Dickinson, G., & Liedtke, P. M. (2004). Impact of a fair value financial reporting system on insurance companies: a survey. *The Geneva Papers on Risk and Insurance. Issues and Practice*, *29*(3), 540-581.

Dongen, B., Dijkman, R., & Mendling, J. (2013). Measuring similarity between business process models. In *Seminal Contributions to Information Systems Engineering* (pp. 405-419). Springer Berlin Heidelberg.

EC (2009). Directive 2009/138/EC of the European Parliament and of the Council of 25 November 2009 on the taking-up and pursuit of the business of Insurance and Reinsurance (Solvency II).

EIOPA (2011). Solvency II – Reporting and disclosure.

EIOPA (2015). Understanding public disclosure under Solvency II.

EIOPA (2016). Implementation of Solvency II: The dos and don'ts. *IVASS Conference 2016 "The Launch of Solvency II"*.

Eling, M., Schmeiser, H., & Schmit, J. T. (2007). The Solvency II process: Overview and critical analysis. *Risk management and insurance review, 10(1), 69-85*.

Fischer, R., Aier, S., & Winter, R. (2015). A federated approach to enterprise architecture model maintenance. *Enterprise Modelling and Information Systems Architectures*, *2*(2), 14-22.

Frederiks, P. J., & Van der Weide, T. P. (2006). Information modeling: The process and the required competencies of its participants. *Data & Knowledge Engineering, 58(1), 4-20*.

Georgakopoulos, D., & Tsalgatidou, A. (1998). Technology and tools for comprehensive business process lifecycle management. In *Workflow Management Systems and Interoperability* (pp. 356-395). Springer Berlin Heidelberg.

Gutiérrez Cordero, M. D. L. (2017). *Análisis del riesgo de caída de cartera en seguros: metodologías de "inteligencia artificial" vs "modelos lineales generalizados"* (Doctoral dissertation, Universidad Complutense de Madrid).

Gutsche, M. (2011). Solvency II-Lesson learned?, Diploma thesis, University of Kassel.

Indulska, M., Recker, J., Rosemann, M., & Green, P. (2009). Business process modeling: Current issues and future challenges. In *International Conference on Advanced Information Systems Engineering* (pp. 501-514). Springer, Berlin, Heidelberg.

Institute and Faculty of Actuaries (2016). Solvency II – General Insurance [Online]. Available at: https://www.actuaries.org.uk/.../solvency-ii-general-insurance [accessed on: 2017-08-25].

IVASS (2016). Solvency II – The new prudential regulation on the insurance sector: a simplified guide [Online]. Available at: https://www.ivass.it/pubblicazioni-e-statistiche/pubblicazioni/altre-pubblicazioni/2016/guida-solvency-ii/SolvencyII_Guide_EN.pdf?language_id=3 [accessed on: 2017-04-05].

KPMG (2011). Solvency II: A closer look at the evolving process transforming the global insurance industry [Online]. http://ivan-shamaev.ru/wp-content/uploads/2013/05/solvency-II_kpmg_english.pdf [accessed on: 2017-04-05].

Ko, R. K. (2009). A computer scientist's introductory guide to business process management (BPM). *Crossroads*, 15(4), 4.

Liebwein, P. (2006). Risk models for capital adequacy: Applications in the context of solvency II and beyond. The Geneva Papers on Risk and Insurance Issues and Practice, 31(3), 528-550.

João M. Silva

Lloyd's (2017). What is Solvency II? [Online]. Available at: https://www.lloyds.com/the-market/operating-at-lloyds/solvency-ii/about/what-is-solvency-ii [accessed on: 2017-03-09].

Leuz, C., & Wysocki, P. D. (2016). The economics of disclosure and financial reporting regulation: Evidence and suggestions for future research. *Journal of Accounting Research*, *54*(2), 525-622.

Mendling, J. (2008). Business process management. In *Metrics for Process Models* (pp. 1-15). Springer Berlin Heidelberg.

Mendling, J., & Nüttgens, M. (2006). EPC markup language (EPML): an XML-based interchange format for event-driven process chains (EPC). *Information Systems and e-Business Management*, 4(3), 245-263.

O'Donovan, M. G. (2014). *Solvency II: stakeholder communications and change*. Gower Publishing, Ltd..

Scheer, A. W., & Nüttgens, M. (2000). ARIS architecture and reference models for business process management. *Business Process Management*, 301-304.

Scheer, A. W., Thomas, O., & Adam, O. (2005). Process modeling using event-driven process chains. *Process-aware information systems*, 119-146.

Taylor, J. B. (2013). Getting off track: How government actions and interventions caused, prolonged, and worsened the financial crisis. Hoover Press.

Ungan, M. (2006). Towards a better understanding of process documentation. *The TQM Magazine*, *18*(4), 400-409.

Van der Aalst, W. M. (1998). The application of Petri nets to workflow management. *Journal of circuits, systems, and computers*, *8*(01), 21-66.

João M. Silva

Van der Aalst, W. M. (1999). Formalization and verification of event-driven process chains. *Information and Software technology, 41(10), 639-650.*

Weske, M. (2012). Business process management architectures. In *Business Process Management* (pp. 333-371). Springer Berlin Heidelberg.

Zairi, M. (1997). Business process management: a boundaryless approach to modern competitiveness. *Business Process Management Journal*, 3(1), 64-80.

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Appendices

Appendix A

Formal definition of EPC

Definition 1 (Event-driven process chain) - An event-driven process chain is a five-tuple (E, F, C, T, A):

- E is a finite set of events;

- F is a finite set of functions;

- C is a finite set of logical connectors;

- T ∈ C → {∧, XOR, V} is a function which maps each connector onto a connector type;

- A ⊆ (E × F) ∪ (F × E) ∪ (E × C) ∪ (C × E) ∪ (F × C) ∪ (C × F) ∪ (C × C) is a set of arcs.

Source: Mendling (2008).

Appendix B

Business Case/Company research

"This is the information you need to disclose at the end of each quarter, starting this March for Solvency II purposes" said the Consultant. Steve, head of the Tidus Insurances' Information Management Office, looked at the board and thought to himself that disclosing that amount of information by 31th March, 2016 would be a Herculean task. It was Thursday, 5th January, 2016.

When the meeting ended, Steve went to his office, sat down and started to think of a way to inform the company's Solvency II team what he had just been told, without causing panic. He knew that the team was still struggling with the big insurance claim

of 5th November, 2015 which could cause major financial problems to the company if not dealt with carefully. With this, the company did not have the possibility of hiring new personnel to perform this exercise. Hence, the team would have to conciliate their current work with this new task. Steve knew that it would be chaotic if he arranged the meeting with the team based solely on the available information. There would be no communication strategy which would help him ease the situation. He needed a plan, a possible solution for the work conciliation problem.

Later that day and with this in mind, Steve called his best friend Mark who worked in Auron Solutions, a BPM solutions company, and both went to dinner. "I am currently facing a difficult situation here and I really need your help" said Steve. When he finished explaining the situation, Mark asked if they had already done this exercise in the past. "Yes, we started disclaiming this kind of information for Solvency II in 2013 but never with this depth. Moreover, bear in mind that we still have the issue of that big insurance claim going on. The team already has a lot of work in their hands but the Solvency II exercise needs to be done" replied Steve. "Well, if you have done the exercise in the past, you can try documenting the Solvency II process. Doing so could really decrease the process' operational risk and optimize the time spent performing it. Hence, the team might be able to conciliate all their work with this task without getting overwhelmed" suggested Mark. Steve liked the idea but explained to Mark that the team would not have time to both document and perform the Solvency II process at the same time. Furthermore, since the financial situation of Tidus Insurances was still unknown, they could not spend much money on a consultant to perform the job. "Do not worry buddy. I know a guy" said Mark while handing over a card with a phone number on it.

"Harry from Jecht Consultancy. Well, if you think he can handle the job, I will give him a call first thing in the morning" said Steve.

Next morning, Steve called Harry and arranged a meeting for that morning in Tidus' headquarters. Harry arrived for the meeting and Steve started explaining both the problem and Mark's suggestion. "The suggestion is adequate and I agree that it can be a viable solution for your problem. Do you make process documentation in this company?" asked Harry. "Yes, we use a tool called ARIS Business Process Analysis" replied Steve. "Well Mr. Steve, I might have just found out the solution for your problem" said Harry.

Suggested discussion topics:

a) How should Tidus Insurances' Solvency II team and Steve approach the implementation issues?

[Teaching note: Refer to Chapter 3 of this work].

b) Research a little bit about Solvency & discuss implications when modeling business processes related to those standards.

[Teaching note: Refer to Chapter 3 of this work, section 3.1 Solvency II].

c) In Harry's shoes, what is your proposed solution to Steve?

[Teaching note: Refer to Chapter 4 of this work, sections 4.1 Documentation methodology & 4.2 Results].

Appendix C

Link for the EPCs:

https://drive.google.com/file/d/0B29kIGSAHxyeckYwdjNZakZjaU0/view?usp=sharing