Conceptual Framework of Anything Relationship Management

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Keywords: Anything Relationship Management, Management Concept, Customer Relationship Management, Relationship Management, Internet of Everything.

Abstract: An increasing interconnectedness of people, physical objects and virtual objects through ICT (information and communication technology) has been observable for years. This is reflected in various fields such as business contacts (e.g. LinkedIn and Xing), social media (e.g. Facebook, WhatsApp and Twitter) or the emerging Internet of Everything (IoE). Particularly companies and organizations have a variety of relationships with their stakeholders, as well as other physical things (cars, machines etc.) and virtual objects (cloud services, documents etc.) today. All those things have to be managed with appropriate approaches. xRM can be used for this purpose as a further development of Customer Relationship Management (CRM), allowing the management of any kind of objects with appropriate mechanisms on a information technology (IT) platform. This document summarizes the results of a research project, whose aims were to develop a conceptual framework for Anything Relationship Management (xRM). Some basic background about xRM, the difference between xRM and CRM and some theoretical foundations of management concepts are described for this purpose. Additionally, the main objectives and principles of xRM will be explained. The development of a conceptual framework for xRM as well as the different components is explained on this basis. Finally, the conceptual framework for xRM gets validated through an implemented example.

1 INTRODUCTION

An increasing interconnectedness of people, physical objects and virtual objects through ICT (information and communication technology) has been observable for years. This is reflected in various fields such as business contacts (e.g. LinkedIn and Xing), social media (e.g. Facebook, WhatsApp and Twitter) or the emerging Internet of Everything. Cisco estimates that in 2020 50 billion devices and objects will be connected to the internet (Evans, 2011). Particularly companies and organizations have a variety of relationships with their stakeholders, as well as other physical things (cars, machines etc.) and virtual objects (cloud services, documents etc.) today. All those things have to be managed with appropriate approaches. xRM can be used for this purpose as a further development of Customer Relationship Management, allowing the management of any kind of objects with appropriate mechanisms on a IT platform. Compared to existing relationship management systems, which usually only represent a partial area of a company, the xRM approach is implemented on a flexible and generic xRM platform that enables a uniform mapping of all relationship management areas of a company. While there are a lot of offers of xRM platforms (Microsoft Dynamics CRM, SugarCRM etc.), there is still a lack of appropriate management strategies and concepts for xRM. Britsch et al. (2012) see this as "one of the central research questions of Anything Relationship Management" (Britsch et al., 2012). The lack of management strategies has often emerged in the ICT sector. The objective in this document is therefore to the development a conceptual framework for xRM as an associated management concept.

This document summarizes the results of a research project. Some basic background about xRM, the difference between xRM and CRM and some theoretical foundations of management concepts are described for this purpose. Additionally, the main objectives and principles of xRM will be explained. The development of a conceptual framework for xRM is explained on this basis as well as the different components. Then the

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conceptual framework gets validated through an implemented example. Finally a conclusion and an outlook for further use are given.

2 FUNDAMENTALS OF XRM

2.1 Definition of xRM

The term xRM has already been defined several times in a variety of ways, by different authors like Radjou et al. (2001), Microsoft (2010) and Britsch et al. (2012). In most definitions xRM is seen as the further stage of CRM as well as the implementation of the theoretical foundations of relationship management. In addition, xRM includes a technological component (IT system or platform) and a conceptual component (management concept and management strategy). In newer definitions xRM is seen as an opportunity to manage objects in the internet of everything (Knoblauch & Bulander, 2014, pp. 237). The following definition covers the main aspects of past and previous definitions of xRM: "Anything Relationship Management (xRM), as an advancement of CRM, is a consistent and holistic concept of Relationship Management between and in-between enterprises, people, physical things and virtual assets. It is based on one or more flexible, modular and scalable IT platforms, which can be focussed on different branches. xRM helps enterprises to capture, coordinate and analyse entities and their relationships as well as processes in the Internet of Everything" (Knoblauch & Bulander, 2014).

2.2 Major Differences between CRM and xRM

Since xRM is a further stage of CRM a comparison is useful. Next these two terms are compared according to different criteria.

Entities and Relationships: The main entities in CRM are the customers and their relationships to the company, the products and the services or the brand. In xRM the customers are only one of many entities, but still the most important one. Besides virtual assets and physical objects xRM also includes all relevant primary and secondary stakeholders of the company. Furthermore xRM connects stakeholders and physical objects in the real world with virtual assets in the virtual world (information world). Each relevant object of the real world always exists as a digital replication in the virtual world.

Management Tasks: A company serves a particular selection of customers. These customers can be differentiated by e.g. their buying behavior, revenue or customer value. Therefore it is important to manage them each in an individual way. An established approach, especially for marketing and sales, is to manage customers depending on their customer value (Günter & Helm, 2006, p. 622). With xRM, however, all relevant relationships of the company have to be managed systematically. This leads to a significantly higher complexity of relationships management. That complexity isn't contained in the individual relationships, but rather in the variation of the relationships.

Objectives: According to Hippner and Wild (2006), the objectives of CRM are to establish profitable customer relationships and a holistic customer-oriented business strategy with CRM systems. The relevant departments of a company must be interconnected and aligned towards the customers for this purpose (Hippner & Wild, 2006). By contrast, the objectives of xRM are to identify and manage all profitable relationships of the company and to map them in a consistent and holistic approach with ICT. Additionally, xRM seeks to increase the relationship quality in all relevant stakeholder relationships, e.g. using quality Key Performance Indicators (KPIs).

Processes: The most important operational processes in CRM can be divided into marketing, sales and service processes. For example, marketing processes include campaign and lead management, sales processes, the opportunity, contract and order management and service processes the feedback and support management (Hippner et al., 2011a). Compared with CRM, xRM can map and manage all business processes that involve xRM entities and their relationships (Britsch & Kölmel, 2011). xRM comprises interactive processes that include different stakeholders, physical objects and virtual assets. This leads to an improvement of internal business processes through a consistent and holistic mapping and managing (Britsch et al., 2012). Besides internal business processes xRM also enables the implementation of cross-company business processes (CAS Software AG, 2012). Such functionality is important for business cooperation in the form of virtual enterprises and organizations.

Integration: On the one hand CRM systems merge isolated marketing, sales and service applications as well as specific internet applications and call center departments into one coordinated system landscape with a Single Source Of Truth (SSOT). On the other hand CRM systems are

integrated between other systems like ERP or SCM systems (Hippner et al., 2011b). xRM in turn cannot be seen as a system, but as a central integration platform that integrates all kind of systems and applications. An xRM platform has a high flexibility and can therefore adopt historically grown systems with their related structures (Radjou et al., 2001). Future xRM platforms must also integrate smart objects like cyber-physical systems (CPS) or virtual objects like cloud computing services (Britsch & Kölmel, 2011).

2.3 Management Concepts for xRM

The authors Britsch et al. (2012) see xRM as "a strategic management approach that integrates and aligns all levels of relationships. In this sense xRM contributes to the systematic management of relationships to all partners, be they horizontal (e.g., joint ventures), vertical (e.g., franchising), or lateral co-operations (e.g., authorities)" (Britsch et al., 2012). One of the central research questions of Anything Relationship Management and BISE (Business & Information Systems Engineering) is how a strategic management concept may look and which design principles have to be used (Britsch et al., 2012). While there are plenty of xRM platforms offered through the ICT market, there is still a gap between appropriate management concepts for corresponding xRM platforms. Therefore, we want to introduce a conceptual framework for xRM consisting of a management concept and a general platform architecture that provides a comprehensive approach to manage xRM in connected society.

The main focus is on a strategic management concept for xRM. Generally, management concepts show interpretations of people, their behavior and the organization that is bound to market conditions, to create an order in the variety of goals, ideas, plans and methods. A management concept can be seen as an abstract design model of the reality, which refers to a desired future order that is achieved through the proper usage of the management concept. Therefore the essential components as well as the relationship and effect structures are mapped, without giving specific guidelines on the possible configurations. The particularly important elements are displayed and highlighted in a management concept. Especially in complex systems and environments, management concepts must have a sufficiently high level of abstraction (Zielowski, 2006, p 112). Before the developed conceptual framework is introduced the most important principles and objectives of xRM are described in the next section. These principles and objectives as well as the general fundamentals of management concepts will be used to design the conceptual framework for xRM.

3 xRM PRINCIPLES AND OBJECTIVES

Despite the fact that there are different publications of xRM (e. g. Britsch et al., 2012 or Alexakis et al., 2014), there is still no clear analysis of core principles and objectives of xRM. In this section we want to point out which xRM principles (table 1) and xRM objectives (table 2) have to be considered when dealing with xRM. The results of these tables were investigated through literature research in books, scientific magazines and on the web as well as expert interviews and the visit of events with topics about xRM (e.g. CeBIT 2014, CRM-expo 2014 and 2. Trendkonferenz forum!XRM). In addition, different xRM platforms and xRM systems were investigated and compared.

3.1 Principles

Table 1: Principles of xRM.

1. Flexible, scalable and interoperable platform
An xRM platform can be seen as a platform-as-a-Service (PaaS) with a software development environment for xRM applications (Britsch et al., 2012). Such a platform has a flexible and scalable infrastructure. Furthermore xRM platforms and their entities should have the ability of interoperability among themselves. Thus, the use of well-defined communication models and communication protocols is necessary (Günthner & Hompel, 2010, p. 79).
2. Configurable framework
A configurable framework is one of the basic elements of xRM. Such a framework provides an implementation of important application services like access management or administration function, a first area of application (typically CRM) and a development environment for function extension. The software development environment includes components like a repository or debug functions and has the ability to install plug-ins.
3. Point & Click Apps/Customization
One benefit of xRM is the possibility to build "Point & Click Apps" and to customize them easily out of the box. This is one of the core principles that xRM contributes and therefore allows the building of apps quickly and easily without having to have deeper implementation skills.

Table 1: Principles of xRM. (cont.)

4. Flexible schema and extensibility
The underlying data model of xRM platforms does not have a fixed schema but a flexible and extensible one. This means that xRM platforms can hold any data model and can generate or extend the data model without much programming knowledge. The xRM platform undertakes the database adjustments and queries for the user.
5. Integration/mapping of various entities
xRM enables the mapping of any kind of entity (stakeholder, virtual asset or physical object) in an application. This allows the fulfillment of comprehensive business requirements on one platform. The next level of xRM is integrating smart objects or shared virtual objects through the internet of everything. As mentioned in point one a standard for communication is required.
6. Implementation of service orientation capabilities and architecture
Many xRM platforms follow the service orientation paradigm and are built on a service-oriented architecture (SOA). This allows serving the platform consumer with service orientated capabilities like immediate availability and well-defined behavior of servicers or service composition.
7. Company-wide and cross-system workflows
Company-wide and cross-system workflows can be established more easily with xRM since one or more interoperable platforms or well-defined communication standards are in place. This leads to less workflow disruptions and a faster flow time as well as a more consistent management of workflows and business processes.
8. Custom GUIs for each user
Any graphical user interface (GUI) of an xRM application can be customized by the user. Depending on user preferences and access restrictions one and the same xRM application can have a completely different GUI.
9. New software releases do not affect the customized data model and application
A customized and extended data model has to be safe for new software releases of the xRM platform. This means that if the platform provider publishes new updates, these updates do not lead to problems regarding the customized data model and application.

3.2 Objectives

While several of the xRM objectives depend on the respective organization or the business sectors, there are also a number of general objectives that can be identified. Those objectives are primarily conceptual ones since the intention of this paper is to create a management concept for xRM.

Table 2: Objectives of xRM.

1. Identification and segmentation of entities and relationships
To handle the different entities in xRM it is necessary to identify and segment them. In addition to a basic classification according to their characteristic (stakeholder type etc.) a second step has to be taken to evaluate them depending on criteria such as profitability or potential. Furthermore all relevant relationships must also be identified and segmented. Unique identification of entities can be implemented by URI (Uniform Resource Identifier), IPv6 or similar concepts and technologies. The identification of people will be the big challenge in terms of uniqueness and the privacy policy. Projects such as "Integrated digita.me User goods" are enormously important for this purpose (see http://www.dime-project.eu/).
2. Control and management of entities and relationships
The right level for control and management for all entities should be found through xRM. Since companies and their organizational structures can be quite complex, appropriate mechanisms are needed that allow the control and management of entities, relationships and corporate structures on different levels.
3. Reduction of complexity and consolidation of data
Using the concepts of xRM should help to deal with enormous amounts of data (big data) the company is faced with. Structured data as well as unstructured data has to be assigned to the corresponding entities and relationships for this. The correct assignment of unstructured data is thereby the big challenge. New knowledge is gained (like the supplier who is also customer) and less storage space is needed through merging data in one entity of the same actor that acts in different roles or is used in different ways. Furthermore the reduction of complexity and the dealing with big data needs appropriate methods like predictive analytics, prescriptive analytics and data mining.
4. Differentiated stakeholder approaches
Just as in CRM, where there are differentiated customer approaches, these principles have to be extended to all stakeholders in the organization. With xRM (concept and platform) a foundation can be given to build and establish differentiated approaches in a systematical and holistic way.
5. Enhancing of relationship quality and contact maintenance
With xRM, relationship quality and contact maintenance should be enhanced for all relevant stakeholders (customers, suppliers, employees etc.). This will lead to a higher loyalty, better relationships and finally it will increase the profitability of the organization. Furthermore it will help to ensure long-term competitiveness and will lead to a continuous improvement of business through the creation of new relationships with stakeholders and the stabilization or the termination of existing ones (Riemer, 2005).

Table 2: Objectives of xRM. (cont.)

6. Identify and know stakeholder objectives
An important objective is to know the individual goals and expectations of your stakeholders, to document them and to coordinate them among themselves in order to strive for win-win situations.
7. Using xRM on the Internet of Everything
The future goal of xRM platforms will be to build a well-defined link to the infrastructure of the IoE, to objects of the IoE as an xRM entity as well as to manage them systematically and to provide stakeholders access and availability to them. This also means that xRM platforms have to be flexibly expandable in terms of their entities and interfaces (Uckelmann et al., 2011). The concepts of the Semantic Web and the Web of Things are therefore becoming increasingly important.
8. Horizontal integration with smart factory
Horizontal integration is a term to link various IT systems used for the different process steps in manufacturing and business planning processes within a company or across multiple companies towards an integrated solution (acatech, 2013). xRM concepts and platforms can be used to build such a solution, if they have capabilities like interoperable. But, more importantly, xRM is not just an IT platform, it is a business strategy and a management concept combined with an IT platform. Thus, xRM can help to implement the horizontal integration of an organization across multiple companies (value added networks) to an integrated solution.
9. Privacy policy
Since xRM is all about data from entities (stakeholders etc.) and relationship management, it is necessary to ensure privacy policy. This requirement is more important than ever. Data and information have become the oil of the twenty-first century. Therefore, a more comprehensible and transparent handling of personal data must be present for protection and trust building.
10. 10.Real-time communications and data safety
To exploit optimization potential in the interconnection of distributed entities and the value creation processes the exchange of data in real time is required. However, real-time integration and communication leads to numerous security threats. These threats can mostly be eliminated by caching incoming data on an isolated server and verifying the data through security software. But in turn this influences real-time communication. Real-time communications and data safety are affected by each other (Federal Ministry of Education and Research, 2013).

4 STRUCTURE AND COMPONENTS

4.1 Overview of the Conceptual Framework

Based on the principles and objects of xRM an xRM conceptual framework has been created with the primary purpose to structure and systematically order the various areas of application, use cases, entities and relationships of an organization.

The xRM conceptual framework includes several components with various elements, methods and models that build an abstract structure of a higher management layer to manage different areas of application. The following figure shows the components and their structure in the xRM conceptual framework.

4.2 Components

4.2.1 Entities

The entities in xRM include three basic forms: people and organizations (stakeholders), physical objects and virtual assets.

People and Organizations (stakeholders): The most important entities for organizations are stakeholders. Based on the three basic types of xRM, stakeholders can be divided into primary and secondary stakeholders.

According to Clarkson (1995) primary stakeholders are people, groups and organization "without whose continuing participation the corporation cannot survive as a going concern. [Secondary Stakeholders however are] those who influence or affect, or are influenced or affected by, the corporation, but they are not engaged in transactions with the corporation and are not essential for its survival" (Clarkson, 1995). Moreover primary stakeholders can be divided into internal and external stakeholders. Secondary stakeholders are always external stakeholders.

Physical Objects: Physical entities are objects of the physical world and are therefore everything that exists materially, except human beings, since they have a distinctive and clearly definable role regarding intelligence and sociality. These entities can be classified in a first step into alive (e.g. animals) and lifeless (e.g. cars).

In a second step, they can be further classified regarding their communication ability with ICT into representation (digital copy of an existing object),

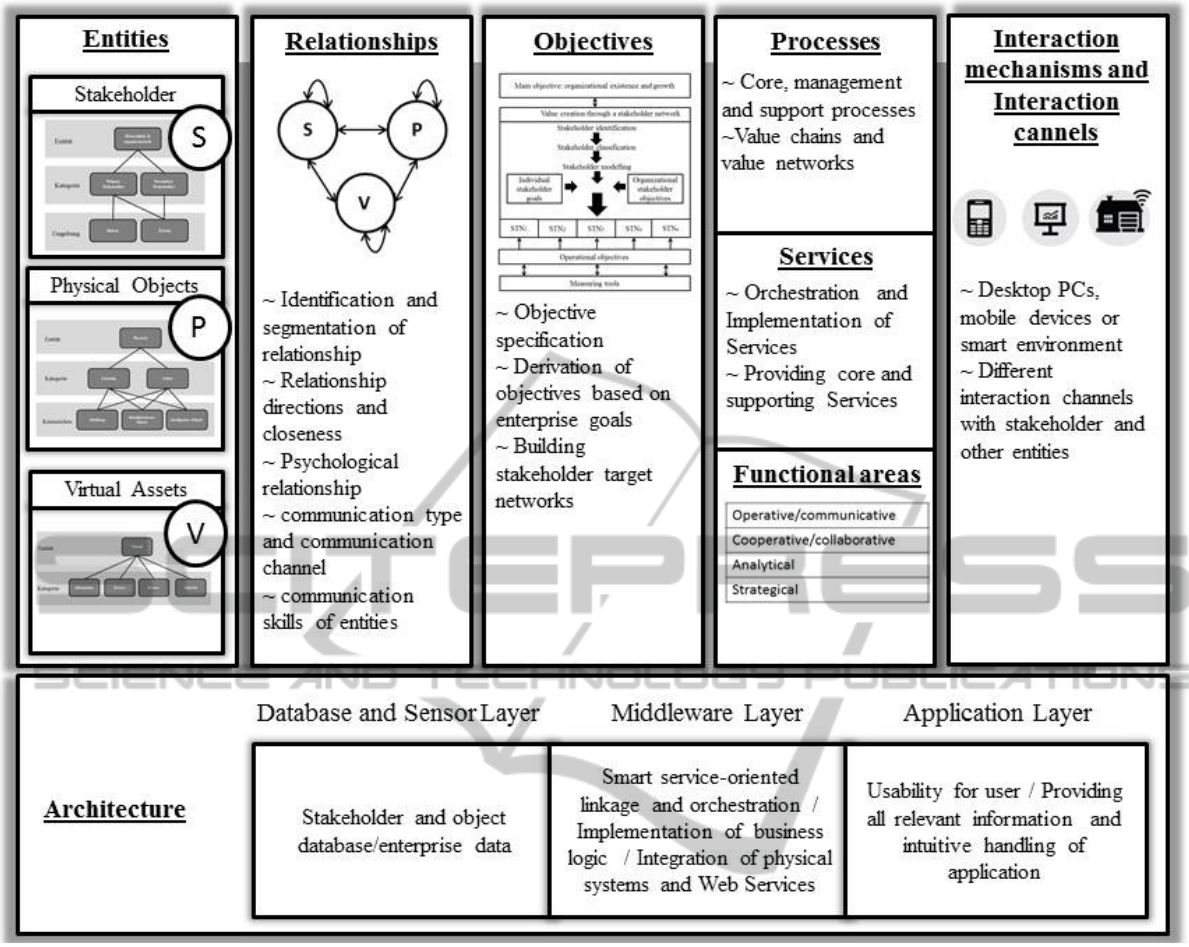

Figure 1: The conceptual framework of xRM.

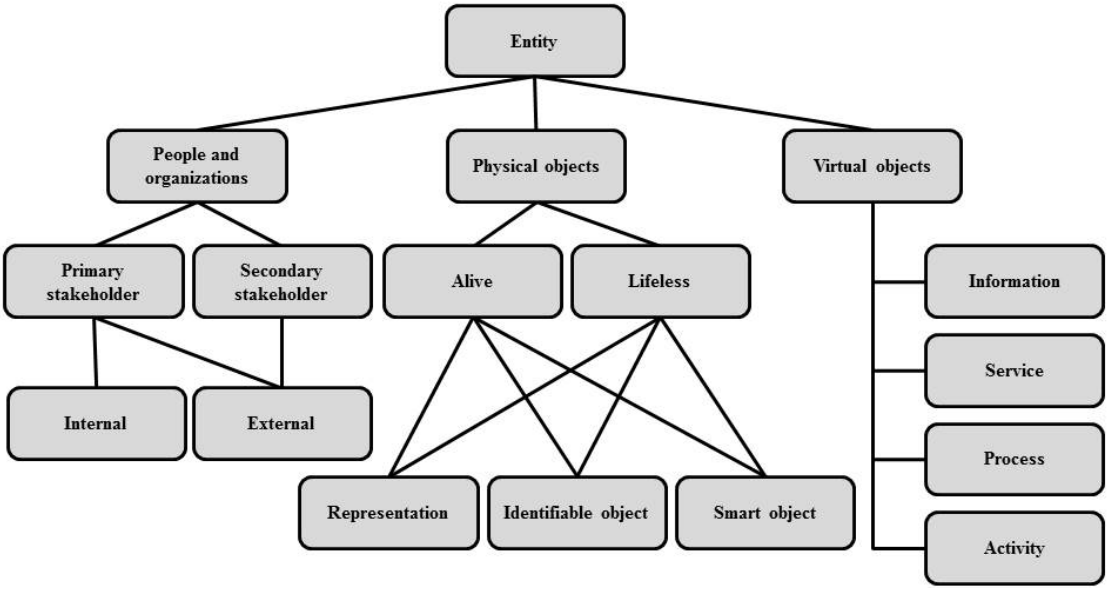

Figure 2: Classification of xRM entities.

identifiable object (has a unique ID for example an RFID-Tag, which is identifiable through ICT) and smart object (can communicate and interact independently with other smart objects (e.g. cyber-physical systems).

Virtual Assets: Virtual entities are objects that only exist in the digital world (information world), even though each object needs a physical storage (e.g. hard disk). A virtual entity is made up of digital data and can be divided into information (e.g. data base, document), service (e.g. cloud service), process (e.g. business process) or activity (e.g. machine activity, machine state).

4.2.2 Relationships

In the component "Relationships" the connections between the entities are identified, described, restricted, and managed. While relationships of virtual assets and physical things can be identified through documentation, logs files or ICT tools, it is more difficult to identify stakeholder relationships. Basic approaches like employee or expert surveys, checklist procedures, analysis of contractual relations, environmental monitoring, analysis of resource relationships and network analysis must be implemented for this purpose (Tewes, 2008).

A basic classification of relationships can take place according to Evans (2012) who divides relationships into P2P (people-to-people), M2M (machine-to-machine) and P2M divides (people-to-machine) (Evans, 2012). Virtual assets and physical things are grouped together as "Machine".

Communication Skills are the primary size for a classification for M2M relations. Hence the relationships of entities can have non communication ability, passive communication ability (e.g. RFID), and active communication ability.

Furthermore there will be a future communication classification according to standard communication characteristics of entities. For example the I40-compliant communication ability which requires certain skills such as communication-capable software components, a unique identification in a network or standardized service functions (VDI e. V., 2014).

Several dimensions have to be considered for stakeholders. The first dimension is the **relationship direction**. This dimension has on the one hand a vertical, horizontal and lateral relationship view and on the other hand an external as well as an internal view (see figure 3) (Diller, 1995).

Another important dimension is the **relationship closeness** which describes how strongly a stakeholder can be influenced by another person or organization. Thereby influence can be made through a direct relationship (stakeholders can be addressed directly) or an indirect relationship (stakeholders can only be addressed through one or more intermediate entities).

Next the **psychological relationship** dimension

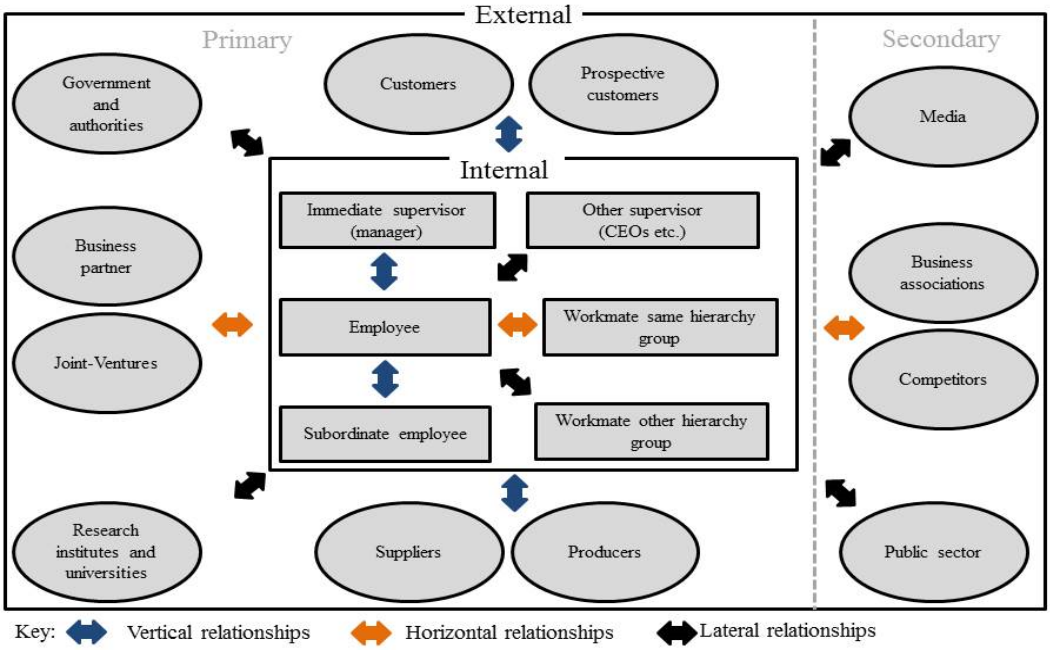

Figure 3: Stakeholder relationships.

has to be considered for relationship quality (Lorenz, 2009, p. 75). A basic classification is done by dividing relationships into weak ones (some interaction existing) and strong ones (fulfilling defined criteria which measures the quality) (Riemer, 2005).

Finally, the **communication type** (personal, digital etc.) and **communication channel** have to be considered. This describes how the communication with stakeholders is achieved (personal, digital etc.) and through which tools. This dimension also brings people and machines together (P2M). According to the communication ability of machines people can interact with them through different channels of communication (e.g. user interfaces, speech recognition etc.).

4.2.3 Objectives

Different objectives have to be defined to highlight the purpose they are needed for based on the entities and their relationships. In the component "Objectives" this definition is done. Therefore it is necessary to clearly specify the objectives, to derive different objectives based on the corporate objecttives and to build objective relationship networks.

Particularly important are the objectives of stakeholders. Here two views can be differentiated: the individual goals that stakeholders have and the objectives the organization has with stakeholders. Information about individual stakeholder goals can be saved within the entity and can be processed when necessary. "Target relationship networks" should be built to connect corporate objectives, organizational stakeholder objectives and the individual stakeholder goals. Referring to Görlitz (2007) such a network could be built as shown in figure 4.

Based on the main corporate objectives which typically are organizational existence and growth, the actual benefits out of stakeholder relationships are derived and defined. Vice versa organizational stakeholder objectives serve the management and corporate objectives if they are achieved.

Depending on the identified stakeholder types, the stakeholder classification and the modeling of their characteristics a stakeholder target network (STN) is built for each stakeholder group. The STN maps, connects and coordinates individual stakeholder goals and organizational stakeholder objecttives through semantic web tools like a graph database.

Furthermore STNs can also be connected among

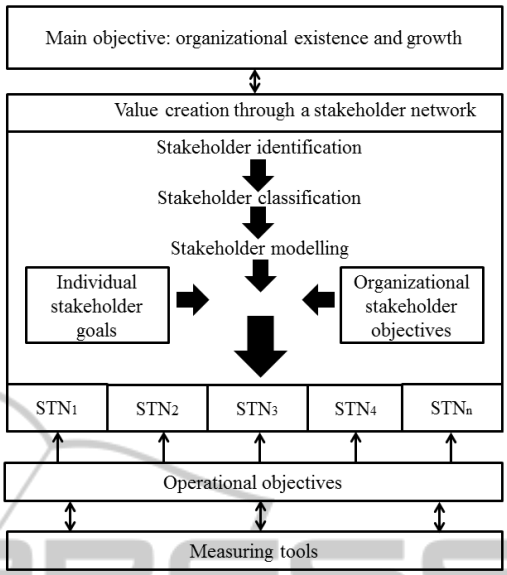

Figure 4: Basic structure of a target relationship network (referring to Görlitz, 2007).

themselves to see the big picture. Objectives in a STN can be referred to operational objectives and vice versa. The stakeholder value for each stakeholder can be determined by measuring operational objectives through measuring tools (Görlitz, 2007). Additionally stakeholder objectives can be compared in terms of possible conflict or complementary objectives. Thus, future issues can be detected early and counteracted. The connection of objectives in and between STNs will allow seeing the big picture and will allow implementing the right services and processes.

4.2.4 Processes and Services

Processes and services are designed to achieve the defined business goals. A process has an input at the beginning, which was triggered by another process or an event and an output at the end, which returns a result. In addition, various entities, relationships and information are involved in processes. Methods and rules are necessary to effectively and efficiently accomplish processes (Bach, 2012, p 136) The result of a process may be a service (like a customer service). But a service can also be a partial step of a process. Services serve a consumer (Stakeholder or other process step) with a specific need.

There are different areas of applications in xRM (e.g. CRM, ERM or smart machine management). Each area of applications has a number of use cases (e.g. sales order, recruitment or real-time analysis of machine data). These use cases again consist of

different scenarios depending on criteria like input, rules, methods and time. The correlation between xRM applications, xRM use cases and xRM scenarios as well as processes and services is shown in the following figure 5.

Basically, business processes can be distinguished between core processes, management processes and supporting processes. But, processes can also be distinguished by their structure.

One variety is the process that consists of a sequence of activities (chain) and which leads to clear predictable results. Such business processes are important when certain quality standards have to be accomplished. A disadvantage of this type of business processes is that the individual process steps are interdependent. If a process step performs incorrectly, this has an impact on all other process steps. In addition, modification, innovation and new outcomes can only carefully be tried, because the effects are often not predictable. The second form of business processes is a network business process. Thereby business activities and business tasks are spread across multiple business services which in turn are not sequenced in a business process, but services that serve other services referring to their respective business goals.

The entities (especially people) that are part of such a service solve problems and deliver solutions through creativity and innovation, instead of executing pre-defined activities. The objective is to give the customer what he wants. The structure can be seen as a network with various connections. Just like in the internet architecture, business processes can take several possible ways towards their outcome. This structure is useful when business process activities cloud fail or are too slow when taking a certain path. The disadvantage however, is that redundancy in the tasks, activities and services have to exist (Gray & Vander Wal, 2012).

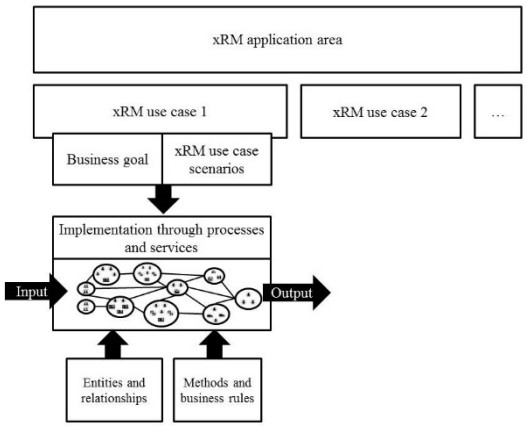

Figure 5: Services and processes in xRM.

4.2.5 Functional Areas

The objectives, processes and services of xRM can be assigned to one of the following functional areas.

Operative and Communicative xRM: The operational and communicative area of xRM includes all elements that are in direct or indirect contact with stakeholders and include the operational business (Hippner & Wilde, 2006). In this area operational business processes and services are implemented and executed and the touch points, interfaces and communication channels with stakeholders (especially customers) are established.

Cooperative and Collaborative xRM: Here projects and strategic alliances are mapped as well as collaboration in the form of "Social Business Collaboration".

Analytical xRM: In this area operational, communicative, cooperative and (social) collaborative data is systematically collected and analyzed to obtain relevant information for strategic management decisions. Methods such as online analytical processing (OLAP), or data mining, stakeholder maps and predictive models for big data scenarios can be used for this purpose.

Strategic xRM: Governance activities depending on organizational structures, current situations and future business goals are placed in the strategic xRM area. In large complex and rapidly chaining organizations (also called business ecosystems) governance can never be located to a single place, a person or top management since it always depends on many different aspects (habits, informal rules, attitudes, external circumstances etc.) and therefore happens simultaneously in many places at the same time (Exner et al., 2009). To manage such an environment effectively governance impulses have to be performed relaying on information about the entities, relationships and individual goals. Governance impulses are not just commands they are mechanics that take all elements and organizational structures into account.

4.2.6 Interaction Channels and Mechanisms

The interaction with the components and their elements mapped on an xRM platform can be done through different mechanisms and interaction channels. Three basic approaches can be distinguished.

Desktop and Mobile: The desktop and mobile access is the most common interaction interface for xRM. Here content is presented to the user through a graphical user interface. The user performs actions (read, save, update and delete) on the GUI using

devices (e.g. mouse and keyboard) or touch screens. In xRM a user can also customize his own individual GUI depending on his used services and preferences.

Smart Environment: A smart environment is typically provided with CPS and corresponding sensors that can interact with the environment and are able to exchange data over networks. People can interact with a smart environment through language, motions or gestures (e.g. smart home scenarios).

API (Application Programming Interface): Here access to the xRM platform can be performed via a programming interface used for M2M communication. Such an interface provides accessible services and functions for other systems and machines.

4.2.7 Architecture

The architecture of the xRM platforms can have different forms and layers depending on xRM provider. The future architecture of xRM will follow the principles of service-oriented architecture and cloud computing. In consideration of these trends a general three-tier architecture is shown in figure 6, since it is a common way to illustrate the platform elements.

Back-end Layer: All relevant data of entities and business is stored in the back-end layer. Besides a stakeholder and object database, in which all entities with their attributes are stored, unstructured data such as documents, social media data and machine data are also stored in this layer and addressed through appropriate metadata if able.

Theoretically, any databases could be used in this layer. But, probably databases like SAP HANA, which also is a platform with many basic services and a strong linkage of data and business logic or NoSQL databases like MongoDB, which is a document-oriented database, will be used in the future.

Middleware Layer: The business logic for xRM applications is implemented in this layer. Therefore this layer offers a framework with basic services (administration, access management etc.) as well as a development environment to implement application via point-and-click or programming. Furthermore the development environment and existing software modules can be extended through plug-ins. Tools for business process management

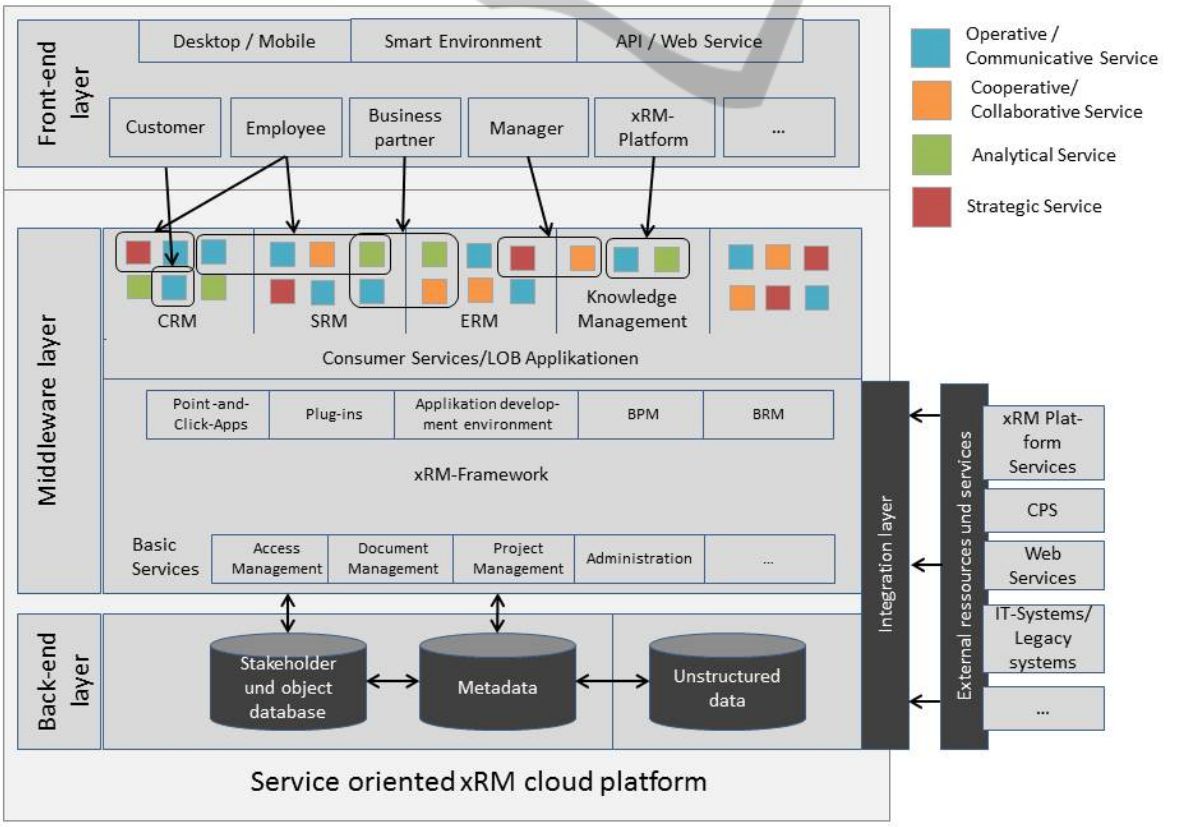

Figure 6: Basic architecture of xRM platforms.

(BPM) and business rules management (BRM) are also provided. Services can be orchestrated, processes can be implemented and finally consumer applications for several stakeholders can be built based on all of these elements.

Integration Layer: A connection to external resources and services is set through the integration layer. This enables the integration of web services, xRM platform services or cyber-physical systems besides legacy-systems.

Front-end Layer: Access mechanisms to the xRM platform applications are provided by the use of the front-end layer through desktops, mobile apps, smart environments, web services and APIs. Each consumer can create his own service bundle, and customize its interface individually. Thus, the different requirements of consumers can be satisfied flexibly and fully.

5 VALIDATION AND EXAMPLE

To validate the developed conceptual framework for xRM an experimental validation was chosen by implementing an xRM prototype with the open source xRM software SugerCRM. For this that the usage of the conceptual framework is described by passing all components form left to right. The requirement was to build a prototype that recreates the structure of a machine for mixing liquids as a service and connecting that service to other entities. The following table gives an overview of the implemented entities.

Table 3: Entities of the prototype.

Entity name	Entity type
Customer	Primary stakeholder
Sales Order	Activity
Order item	Information
Ingredient	Product
Supplier	Primary stakeholder
CPPS-Service	Service
CPPS-Module	Smart object
CPPS-Component	Smart object
Owner	Primary stakeholder

Those entities were related among themselves by developing a data model which was then implemented in SugarCRM through an existing point & click function. The main relationships were between the CPPS-Service (Cyber-physical Production Systems)-Service and other entities. A CPPS-Service is built up out of one-to-many CPPS-Modules which in turn are built up out of one-to-many CPPS-Components (sensors and actuators). Additionally, a CPPS-Service and a CPPS-Module both have a many-to-one relationship to an owner who is responsible for those entities. Finally, the production task saved in an order item can be taken over by one CPPS-Service. A CPPS-Service can take over many production tasks. The main objectives were to easily give customers and employees access to a mixing liquid service on the xRM platform as well as to view random created sensor and actuator values through an xRM user interface. Those values should be continuously updated via web services. The main processes were the sales order process and the production process of mixing liquids. Besides mapping those processes on the xRM platform an additional function was implemented that enabled all relevant information of each order item to be saved via XML to transmit it to an existing mixing machine. The main service was the CPPS-Service, mixing two chosen ingredients in a designated mixing ratio, amount and volume per filling. Another service we implemented allowed viewing sensor and actuator values through a user interface section in the home screen of the SugarCRM software. The xRM prototype can be allocated to operative and communicative xRM. Access to interaction channels and mechanisms was enabled through the inbuilt SugarCRM user interfaces via web browser. We used the three-tier architecture of SugarCRM to build our prototype by saving entities and relationships in the back-end layer, building processes and services in the middleware layer, integrating sensor and actuator values through the integration layer and finally visualizing relevant data as well as functions in the front-end layer.

6 CONCLUSIONS

At the beginning of this paper we explain important fundamentals about xRM. Besides a definition of xRM as well as a comparison of xRM with CRM we also highlighted the need for management concepts and explain what they are. By using the theoretical fundamentals of management concepts as well as the principles and objectives of xRM, which were illustrated in chapter 3, we designed a conceptual framework for xRM. This conceptual framework has the primary purpose to structure and systematically order the various areas of application, use cases, scenarios of xRM in organizations. The main components of the conceptual framework are: entities, relationships, objectives, functional areas,

services, processes, interaction mechanisms and channels as well as the system architecture. The conceptual framework for xRM consists of a static management concept (how do I want to use the conceptual framework and for which business goals) and an xRM platform (which platform do I want to implement the xRM applications with). By using this conceptual framework a systematic approach is given to build xRM application and to reduce the complexity of business areas and relationship varieties in relationship management.

The connections through ICT between people and machines and among each other will expand in the future. This will lead to a significant increase in data volume and data traffic. Furthermore, the Internet of Everything, the cloud computing technology and the mobile internet as well as the digitization and automation of knowledge work will lead to an enormous economic potential. We will have future challenges in data transmission infrastructure and privacy policy. But the future progress will also lead to new innovative business models. xRM will become more and more important in business and in private use (e.g. smart home). The quick and secure connection of entities to xRM platforms, as well as the interoperability of these platforms is one of the future technological challenges in the ICT sector.

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