A Process Mining Based Model for Customer Journey Mapping

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Abstract. Customer journey maps (CJMs) are used to understand customers' behavior, and ultimately to better serve them. This new approach is used in numerous disciplines for different purposes. As a response, several software applications have emerged. Although they provide interfaces to understand CJMs, they lack measures to assist in decision making. We contribute by proposing a CJM model. We show its potential by using it with process mining, a data analytics technique that we leverage to assess the impact of the journey's duration on the customer experience. The model brings data scientists and customer journey planners closer together, the first step in gaining a better understanding of customer behavior. This study also highlights the prospective value of process mining for CJM analysis.

Keywords: customer journey mapping, process mining, customer journey analytics

1 Introduction

Customer journey mapping is a technique that enables professionals to better understand customers' experiences when they interact with the steps involved in a service. These interactions, called touchpoints, are increasing [10] and are used by customers in erratic ways [17]. Hence, being able to use CJMs is becoming increasingly important for companies. Recently, Gartner predicted that by 2018, 60% of large organizations will develop in-house customer journey mapping capabilities [6]. CJMs are not only applied to sales, they are used in disciplines as diverse as healthcare [21], and library science [2, 13]. For instance, Fig. 1 shows a CJM from [21] that is used to understand factors influencing vaccination decisions. It has elements that are often found on CJMs: touchpoints (e.g., consultation experience), stages (e.g., pre-vaccination), and emotions (i.e., factors influencing the decision). Although many companies have used CJMs, multiple ways to create them exist [13, 18] and hence they are usually not consistent nor mutually compatible [14]. Overall, no standard exists for CJMs [15].

Interestingly, Følstad et al. distinguished two uses of CJMs: one aiming to represent anticipated journeys, called the *expected journey*; and a second one, the *actual journey*, which aims to describe how the journey was "really" experienced by customers [8]. We believe that the full potential of CJMs is still to be explored

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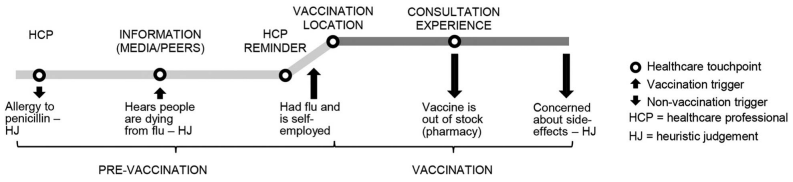

Fig. 1. CJM depicting factors influencing vaccination decisions [21]

by interplaying *expected* and *actual journeys*. For instance, traces of customer journeys available in information systems could be used to build a CJM from facts. Then, this CJM can be compared with an expected CJM–typically drawn on paper for strategic or ideation purposes–to highlight differences. As noted in [18]: "people don't behave like robots, and no matter how well we craft an experience, they will not perceive exactly as we anticipate or hope". In order to discover gaps between expectations and experiences, Gartner states that CJMs should be adopted by organizations as part of their regular practice [16]. However, the customer journey analytics market "is a nascent, highly fragmented market with many vendors offering partial solutions" [6].

Process mining is a discipline that has the ability to play with process models and events logs to deliver fact-based insights [1]. We foresee an opportunity to use process mining for CJMs for two reasons. First, process mining works with event logs, a sequential format ideal for representing CJMs. Second, working with expected and actual models is at the core of the process mining framework (detailed in Sect. 4). In [3], we have discussed process mining in the context of sales and how a structured approach can ease the transition of sales from "art" to "science". More specifically, this present paper exposes new challenges for the process mining community to apply novel techniques with CJM data.

The goal of this research is threefold: (1) to clarify the components of CJMs, (2) to propose a model for CJMs, and (3) to illustrate how process mining can be used to analyze CJMs. The findings should make an important academic contribution to pave the way for further analytics-oriented usage of CJMs.

This paper is organized as follows. Section 2 describes the literature research and the main components of CJMs. Section 3 sets out a proposal for a CJM model. Section 4 illustrates how the model can be leveraged with process mining techniques. Section 5 concludes the paper and provides an outlook.

2 Literature Review

We conducted the literature review with the following question in mind: *What concepts appear in a CJM and how do they relate to each other?* We used the following keywords up to October 2016: "customer journey mapping" OR "customer journey map" OR "customer journey maps" OR "map the customer journey" OR "mapping the customer journey" on Scopus (58 results), IEEE Xplore (15), DBLP (8), and Web of Science (2). Altogether, we found 69 distinct articles. Then, we reduced the selection to 13 [2, 4, 5, 7, 10–15, 17, 20, 21] by removing

a review of a conference, and work that only briefly refers to CJM (55). Finally, we appended two important references [18, 19] often cited. Interestingly, most of the research has been published after 2012, highlighting the novelty of CJMs.

2.1 Components of a CJM

This section presents the main components of a CJM based on information synthesized from our literature review. These are: customer, journey, mapping, goal, touchpoint, timeline, channel, stage, experience, lens, and multimedia.

Customer. A *customer* is the stakeholder experiencing a service [21]. A loose definition should be employed here as it includes people such as patients [21], students [2, 13], or software users [7, 12]. In [19], the authors highlight the importance of collecting sociodemographic information to ease CJMs users to put themselves in customers' shoes. When a customer is mentioned as a fictional character, the term "persona" is sometimes used [10, 14, 19, 20].

Journey. A CJM contains at least one *journey*, which is a typical path followed by a customer. Two types of CJMs exist. One is designed by internal stakeholders to describe what an ideal journey would look like [2], which identifies opportunities for novel services [14] or is employed as a diagnostic tool [19]. We refer to the latter as the *expected journey*. In contrast, the *actual journey* showcases how a journey is experienced by the customer, finds existing customers' problems or needs [2, 7, 14, 15], or pictures the consumption of services by customers [4].

Mapping. *Mapping* is a process consisting of tracking and describing customers' responses and experiences when using a service [2, 5, 10, 13]. Ultimately, these elements are reported on a map.

Goal. A customer journey should be mapped with a *goal* in mind [14, 20], which is also referred to as scenario [2], prompts [13], story [15], or main intention [14]. It triggers interactions with users [2], and streamlines the thought process for users [13]. The goal "connect a low-cost hardware device, such as an Arduino board, to a desktop computer" [7] is a typical example from the literature.

Touchpoint. A *touchpoint* is an interaction between customers and companies' products or services [2, 11, 14, 21] such as "searching for a product" [7], or "finding seats" [11]. The arrangement of touchpoints can be *cyclic*: a customer can iterate a few times over the same touchpoints [18]. Moreover, the arrangement is *non-linear:* (1) most of the time, the customer will not go through all the existing touchpoints [13, 18]; (2) the customer might miss a planned touchpoint; and (3) the customer can unexpectedly quit the journey.

Timeline. The *timeline* describes the duration of the journey from the first until the last touchpoint [12]. Due to the forecast nature of expected journeys, it would not be surprising to not have a timestamp. Yet, a number attached to an event (i.e., touchpoint) can depict the *sequence* within the timeline [13].

Channel. The *channel* is the method chosen by the customer to interact with the touchpoint [13, 17] such as a "reference desk" [13] or "social media" [19].

Stage. A *stage*, encompasses several touchpoints. Some authors used the splits: before, during, and after the experience, but employing domain-related

steps is also possible. For instance, in [12], the stage refers to the waterfall model (i.e., software development). Some CJMs do not use stages at all [2, 7, 11, 15].

Experience. The *experience* encompasses customers' feedback and emotions. We identified three elements to express the experience. The first one is the *emotion*. Using only one continuum of emotions–such as unhappy to happy–may fail to depict a customer's experience [7]. Thus, describing the emotion requires some flexibility. Second, the *scale* measures how positive or negative the experience was for the customer [11]. Third, many studies use customers' *quotes* to represent what customers have been through [5, 7, 15, 21].

Lens. Some components of CJMs are *domain-specific*. For instance, in [15], the authors appended a layer to indicate the weather because it impacts customer satisfaction when using the service. We refer to a layer with the term *lens* to reflect that multiple views are possible on the same map [12]. Suggestions and opportunities [2, 13] are some other examples of lenses superposed on top of touchpoints. They are important because they promotes reflection and analysis of what happened during the journey [12].

Multimedia. The usage of *multimedia* makes a CJM engaging and simple to understand [13, 18, 19]. For instance, recording customers while they are filling out the CJM allows to better understand them [5, 7, 11]. Multiple *types* of multimedia are reported: audio [5], video [7, 11], photos [11], and sketches [18].

To conclude, we observed the use of CJMs for *different purposes*, including to increase understanding [13, 21], to involve [7, 11], and to communicate [5]. Having laid the foundation of CJMs, we build on it to propose a model for CJMs.

3 Proposal for a CJM model

Our proposal–visible on Fig. 2–consists of a XML structure to store CJMs using the main concepts pointed out in Sect. 2. The proposal is drawn upon the *IEEE XES standard* [9], which is the prominent format to import logs in process mining software. Due to space restrictions, the XML does not instantiate all the proposed components, but it should suffice to understand the mechanism.

The example delineates a hypothetical situation in the retail industry. Alice (a customer) called to complain. Therefore, the top management decided to map her journey based on historical data. They observed three events: (1) Alice asked for a quotation, (2) she received the quotation, and (3) the call she made to complain. The next lines render the corresponding XML:

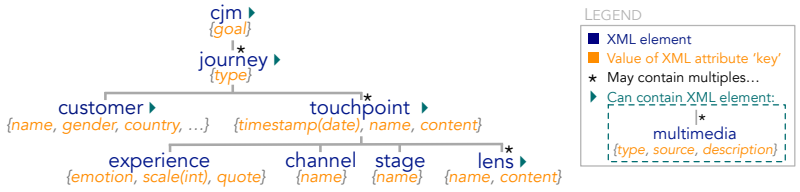

Fig. 2. Hierarchical presentation of CJMs' components

```
<cjm>
  <string key="goal" value="Understand why sales processes take so long"/>
  <journey>
    <string key="type" value="actual"/>
    <customer>
      <string key="name" value="Alice"/>
    </customer>
    <touchpoint>
      <date key="timestamp" value="2016-05-07T10:26:10"/>
      <string key="name" value="Asking for a quotation"/>
    </touchpoint>
    <touchpoint>
      <date key="timestamp" value="2016-06-08T10:18:03"/>
      <string key="name" value="Receiving the quotation"/>
      <lens>
        <string key="name" value="observation"/>
        <string key="content" value="The duration is too long"/>
      </lens>
    </touchpoint>
    <touchpoint>
      <date key="timestamp" value="2016-06-08T11:52:12"/>
      <string key="name" value="Calling the helpdesk"/>
      <string key="content" value="Complaining about delay"/>
      <experience>
       <string key="emotion" value="Frustration"/>
       <int key="scale" value="-2"/>
      </experience>
    </touchpoint>
  </journey>
</cjm>
```

In order to map the journey, we start from the root element "cjm". Our model allows for the description of a "goal" (in orange in Fig. 2 and in the code) described within an element "string". This notation refers to attribute coding from XES [9]. Going down the tree, an element "journey" is created. This CJM contains only one journey, but our model allows for more than one (denoted by * in Fig. 2). We move forward with the "customer" attribute, which allows us to describe Alice. Different levels of detail are provided for each touchpoint that illustrates the flexibility of the model. For instance, the first one indicates only the name of the touchpoint and the time, while the second one has a lens "observation". Finally, we represent the "experience" using two attributes: *emotion*, and *scale*.

We made two decisions for the model. First, *we only consider front-stage activities*; i.e., the ones visible to the customer. Second, *we only consider the path to be potentially cyclic and non-linear* (see "Touchpoint." in Sect. 2), excluding gateways as described in [2] (e.g., "XOR" in BPMN). We argue that from companies' perspectives, customers' paths can only be influenced, but not controlled [18]. Moreover, a journey represents a path performed by a single customer. If that was not the case (i.e., gateways allow a single path to represent multiple alternative journeys), we anticipate that the multiplication of touchpoints [10] and the freedom that customers have to navigate through them in their preferred orders [17] would lead to a meaningless map showing that anything can happen in any order (referred to as a "flower model" in the process mining literature [1]). We believe that these decisions allow to reduce the complexity of the model by emphasizing the main goal of CJMs.

4 Integration with Process Mining

Process mining provides a set of tools that support multiple ways to discover, monitor, and improve processes based on real event logs. Its main idea is to provide a link between process models (e.g., BPMN) and the "reality" captured

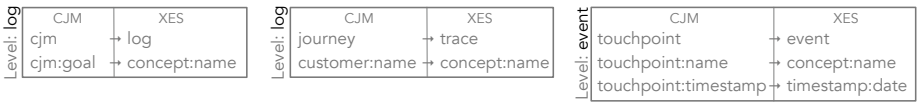

Fig. 3. Mapping between XES and the CJM model

in event logs [1]. We distinguish a "de jure" model from a "de facto" model. The former is normative, as it intends to steer or control the reality. In contrast, de facto models aim to delineate reality. Process mining provides a plethora of algorithms to analyze or join both worlds. For instance, one can *discover* a "de facto" model from the event logs [1]. In turn, one can *compare* this former model with a "de jure" one. The top box in Fig. 4 shows the process mining framework as presented in [1]. If we introduce such techniques and if we align our model with XES–a standard born within the taskforce on process mining–we have done so because *we envision an opportunity to integrate CJM with the process mining framework*. Indeed, we expect the knowledge acquired to combine data on top of models in the process mining discipline to provide a basis to tackle customer journeys using a rigorous approach. Respectively, the *expected* and *actual* CJMs correspond to the *"de jure"* and *"de facto"* process models (see Fig. 4).

The Fig. 3 shows the mapping of the XES concepts to our model. Once the mapping is done, the data can be analyzed with process mining. We will illustrate this by describing how the company could use event logs to answer the following question: *does the duration between asking the quotation and receiving it affect the customer's experience?* We created synthetic journeys that we imported in Disco[1]. These process mining activities are also possible in ProM[2] and most of process mining tools as they constitute basic activities in them. The process mining activities and the results are visible in Fig. 5. This example is only the tip

[1] https://fluxicon.com/disco/
[2] http://www.promtools.org/

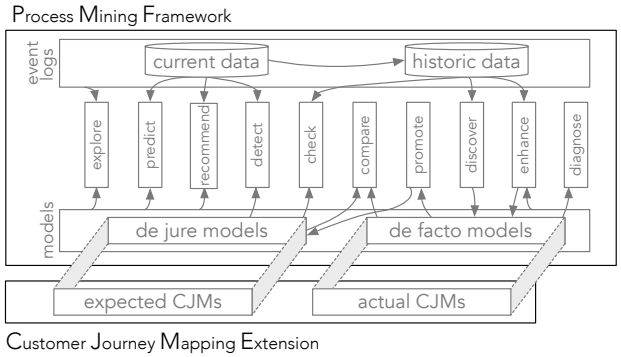

Fig. 4. Process mining framework from [1] extended for CJM

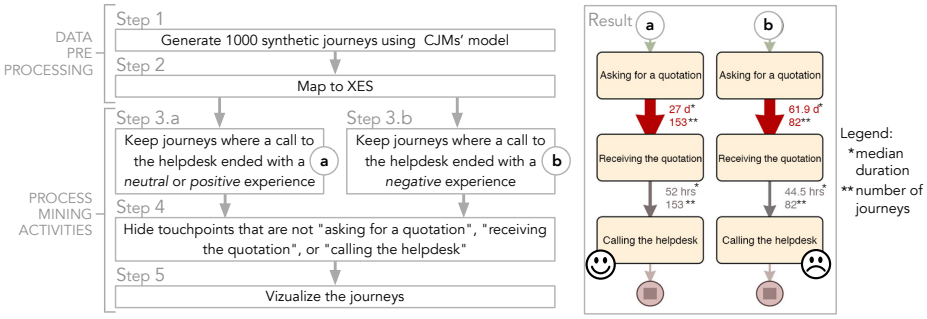

Fig. 5. Simple scenario for the application of process mining on CJMs data

of the iceberg of all the possibilities offered by process mining. The next section addresses these opportunities and concludes this paper.

5 Conclusion and Outlook

We contribute by providing a model that supports practitioners by clarifying the components of CJMs. By purposefully drawing upon a standard born within the process mining taskforce, our model inherits interesting features: (1) it is easily exploitable by data analytics tools, (2) it is extensible to fit a domain-specific application, and (3) it is not tool-dependent. By bringing process mining techniques and CJMs closer together, we closes the gap between actual and expected CJMs and we shed light on a potential new area of research, which requires further investigations with real-life collections of CJMs.

Indeed, new process mining algorithms that fully leverage CJM specificities are required. For instance, we anticipate that new techniques and metrics are needed to cluster journeys and their representatives, to predict the next customer's touchpoint, and to navigate among the journeys. We foresee that future studies will benefit from the existing environment and knowledge of process mining.

To conclude, we believe that the advances in the sentiment analysis algorithm, the growing complexity of customers' needs, and the expanding amount of data produced provide an exciting opportunity to advance our knowledge of CJMs with empirical tools.

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