Author(s): Sharma, Ravi S.; Shaikh, Aijaz A.; Li, Eldon

Title: Designing Recommendation or Suggestion Systems : Looking to the Future

Year: 2021

Version: Accepted version (Final draft)

Please cite the original version:

**Designing Recommendation or Suggestion Systems:
Looking to the Future**

Ravi S. Sharma
Professor
ravishankar.sharma@zu.ac.ae
College of Technological Innovation, Zayed University,
144534 Abu Dhabi, United Arab Emirates

Aijaz A. Shaikh*
Postdoctoral Researcher
aijaz.a.shaikh@jyu.fi
Jyväskylä University School of Business and Economics
P.O. Box 35, FI-40014 University of Jyväskylä, Finland

Eldon Li
Chair Professor
eli@calpoly.edu
Department of Management Information Systems, College of Management
National Chung Cheng University, Chiayi, Taiwan

*Corresponding author
+358 46 9516017

Designing Recommendation or Suggestion Systems:
Looking to the Future

Abstract

A Recommendation or Suggestion System (RSS) helps on-demand digital content and social media platforms identify associations amongst large amounts of transaction data, which are then used to provide personalised viewing and shopping recommendations to consumers. This preface introduces how RSSs are used in the marketplace and various purposes it serves. This paper is a contribution to the ongoing research beyond content-based recommender system. It presents an examination of how the Collective Intelligence Social Tagging System makes a fundamental difference to content-based recommender systems and a suggested hybrid approach to RSS architecture which uses crowdsourcing and tagging to increase the accuracy of content-based RSSs. The lack of a huge data repository for online and e-commerce enterprises restricts the effectiveness of the content-based approach, so RSS research must aim to address these issues and propose a novel approach which incorporates the best of both methods. This preface also introduces three articles which present alternative approaches to effective recommendation approaches. On the social dimension, the use of invasive methods which capture user profile in order to influence behaviour, have opened a pandora's box of legal and ethical considerations. The design of future RSS cannot ignore these constraints.

Keywords: Digital business; recommender systems; design and architecture.

1. Introduction

This preface to the special issue entitled "Recommendation Systems in Electronic Markets" is an introduction to the use of recommendations and suggestions in the digital marketplace in order to capture value. The business value of an RSS is that it helps e-businesses (including e-commerce) such as Netflix and social media platforms such as YouTube to identify associations amongst large amounts of transaction data, for the purpose of providing personalised viewing and shopping suggestions and recommendations to viewers and consumers. RSSs thus represent a significant opportunity for monetization and provide a competitive advantage to firms in the electronic marketplace by helping with up- and cross-sales (Heimbach et al. 2015), reducing the time consumers spend searching for what they need (Köhler et al. 2016) and other innovative forms of bundling digital content and products.

Developing state-of-the-art RSSs—defined as software agents which are widely utilised in online platforms to obtain users' preferences and interests, which in turn are used to generate product or service recommendations (Heimbach et al. 2015)—has proven remarkably popular in the e-commerce industry for retrieving and recommending the most relevant information regarding items, services and products for users (Khan et al. 2018). It is an intuitive tool to overcome the information overload problem affecting electronic markets. Recently, Hsu et al. (2018) conducted an extensive survey of the literature on RSSs and mapped RSS techniques with application domains, with potentially significant impact. They reported that an RSS can be defined as an innovative means of overcoming the limitations of e-commerce services by using customer behaviour and information to identify customer preferences and to proactively suggest products or services (Hwangbo et al. 2018). Its business value lies in that it helps electronic (and mobile) commerce platforms identify associations among large

amounts of transaction information to provide personalised content to users and thus improve user engagement. Prior research (Feng et al. 2015; Zihayat et al. 2019) has established that a successful RSS considers customer needs, maximises customers' satisfaction with their choices, and exerts great impact on overall customer satisfaction. Prior to the development of new systems, such as electronic commerce, the traditional method of recommending products or services was known as 'word of mouth' or 'e-word of mouth'

The intense competition and constant change of the world of e-commerce has made continuous improvement of RSS essential. Conducting design research to recognise the effectiveness of CIST will thus help online sales. For the most part, such businesses depend on content-based recommendations to improve the functionality of their current RSS. Resolving the insufficiencies identified through the research reported in this paper can further improve user experience and satisfaction. Considering that such a hybrid approach also includes the application of content-based recommendations (Salam 2016), the intended objective of this research is to suggest a more effective RSS for e-tailing platforms. Online content providers are not behind in adapting to this era of personalisation; rather, they cater to a plethora of diverse customers. They present content consistent with current trends, regardless of the nature of the products they offer (e.g., films, music, cosmetics, etc.). Consequently, the most popular and successful content providers design their RSSs as personalised services and use them to predict ratings and suggest similar choices to users, depending on a user's browsing and selection history.

Amongst the most common architectures, content-based systems, implement user preferences and descriptions of their items to match those items to users. This approach considers active users and is quite accurate, even if little data from other user ratings is available. However, there are drawbacks to this approach, such as not being able to recommend items if an RSS lacks sufficient information on the metadata of the item profile. There is also an over-specialisation problem, which arises due to recommendations that are based on selective attributes only (Son and Kim 2017). For example, while choosing a fiction movie, the banner name, such as Marvel or DC, is more important than the name of the director. However, if more appropriate information on categorisation is not available, then the choices recommended are biased, and more categories, such as the actors and characters involved in the content, are needed.

The alternative—the collaborative filtering RSS, which is quite popular in business and research—also has drawbacks, such as insufficient input data and a cold start problem. It is also vulnerable to fraudulent profiles. If the number of users increases, the collaborative filtering approach fails because it cannot recommend accurately, so it requires periodic upgrades (Salam 2016; Son and Kim 2017). Although there are drawbacks in both the content-based and the collaborative filtering approaches, the former is more effective and useful for introducing a tag-based system aided by a crowdsourcing platform. Such an approach is aimed at mitigating the drawbacks of the content-based RSS. In recent years, many leading movie streaming and review platforms, such as Netflix, Rotten Tomatoes, IMDB, etc., are using the content-based approach effectively (Bergamaschi and Po 2015).

We could use the notion of collective intelligence through social tagging to aid our combination approach, which will secure better outcomes. There is strikingly little previous research regarding how to use collective intelligence, including leveraging it to gain a competitive advantage. Moreover, few studies have provided specific frameworks, models, measures or use-cases for success.

The purpose of this preface is three-fold. First, it aims to contribute to the ongoing debate on the content-based recommender system in the online movie sales realm. Second, it examines how the CIST makes a fundamental difference to the content-based recommender system. The suggested hybrid approach to RSS architecture involves the use of crowdsourcing and tagging to increase the accuracy of content-based RSSs, because prior research (cf. Park et al. 2012; Hwangbo et al. 2018) has revealed that the current content-based approach has a number of shortcomings, such as less data categorisation and fewer features. Third, the lack of a huge data repository in online or e-commerce enterprises restricts the effectiveness of the content-based approach. RSS research should therefore aim to address the above issues and propose a novel approach which adopts the best of both methods.

The remainder of this preface is organised as follows. In the next section, we revisit the place of RSS in electronic markets. This is followed by the state of the art in RSS design architecture in Section 3 where we also draw implications from previously published research. In Sections 4, we present fruitful avenues for future RSS research. Finally, we present the three articles that comprise the Special Issue and conclude with suggestions for increasing the affordance levels of users and mitigating the key drawbacks of current RSS design.

2. Recommender Systems in Electronic Markets

The significance of RSSs can be gauged by recent Business Insider reports (www.businessinsider.com.au), which state that more than 80 per cent of Netflix's business comes from recommendations or suggestions; less than 20 per cent originates from traditional search methods. Netflix, which is the world's leading internet entertainment service, believes that it could lose up to 1 billion USD or more every year from subscribers who would abandon the service if it did not deploy and enrich its personalised recommendation engine. Similarly, Google has recently introduced an improved design and recommendation system to the home screen of its YouTube app to attract viewers into longer watch sessions to 'create the feeling that YouTube understands you'. Apple's Watch List recommends content and includes accompanying marketing messages across their Apple TV devices via a 'universal search and suggestion mechanism' which delivers information as quickly as possible. Mighty TV is a meta-RSS that allows consumers to swipe through lists of movies and shows across service providers, such as Netflix, Hulu and HBO, suggesting new movies based on profiles. In a value-added feature known as a 'mash-up', consumers can connect with friends through the site's RSS algorithm to find what tastes they have in common, from shows to specific actors.

Classes of RSS Architecture

However, while high-quality, personalised recommendations benefit users, online businesses may violate state and international laws if they collect too much user data or if they globalise its use. It is therefore timely to consider the design of a state-of-the-art approach that can be adopted in global electronic markets. It is taken for granted that online customers obtain/access digital products from a host of platforms, including iTunes, Google Play, Amazon Prime Video and Netflix, at their convenience. In order to enhance user experience and sales, most leading online retailers (e-tailers) have built their own recommendation systems. Commonly used recommendation approaches include content-based filtering, collaborative filtering and hybrid filtering. Online enterprises which rely on the content-based

filtering approach are hampered by insufficient item information, which often results in less accurate recommendations (Salam, 2016). In the absence of an effective method to work around this issue, a hybrid method known as Collective Intelligence Social Tagging (CIST), which incorporates content-based recommendations, has emerged and could close the gap between actual and desired performance.

Wang and Sharma (2018) and Sharma and Kale (2018) conducted field experiments to examine the functionality of content-based recommender systems which incorporate CIST. This hybrid architecture covers both the front-end and back-end of user experiences. Empathic design specifications were collected from IT developers, experts and novice users during 15 semi-structured design interviews to first determine user-developer perspectives on CIST, and then their overall design input. Based on our analysis, we recommend three design principles for implementing CIST: 1) clustering tags to avoid synonymous tag confusion and to create metadata for digital content under the same tags; 2) using a five-criteria framework to better foster end users' trust and eventually contribute to increased tagging; and 3) providing a clear way of distinguishing and displaying primary and secondary tags which separates them and gives users the opportunity to assess whether they reflect the relevant theme of the digital content they are applied to (e.g. movies, songs, books, etc.).

Among the various tag-based systems, social tagging has emerged as a valuable technique for tagging with tools such as Flickr, Furl, Instagram, etc. In the Web 2.0 era, users have become more active and a major source of generating new content online (Foo et al. 2015). End users are allowed to assign personal labels or tags to sites for sharing, discovering, resourcing, etc. By contrast, e-tailers benefit significantly from this tagging behaviour because it enables them to discover user behaviour at different levels to tailor services to those users. Social tagging has become popular on the Internet as an efficient way to organise and manage resources. The tags themselves carry useful information regarding the product, such as its characteristics and expressions (Zheng and Quidan 2011). Studies suggest that crowdsourcing has evolved as a methodology for gathering data. The word combines 'crowd' and 'outsourcing', which together indicate that 'two heads are better than one'. Crowdsourcing is a way to receive feedback from the community for whom the products and services are being designed (Haren 2017).

Research Gaps in RSS Architecture

MTurk is another useful tool for tagging items based on a crowd-sourcing technique. Nguyen-Dinh et al. (2013) conducted experiments of tagging human activities in videos by using MTurk with highly accurate tags (76–92%). It showed the effectiveness and feasibility of generating tags in videos using crowd-sourcing. Thus, it is possible to use crowd-sourcing to tag movies and generate more social tags to enrich movie features (e.g. film genres and plot keywords) to increase the accuracy of recommended results.

Hsueh et al. (2009) introduced three selection criteria for determining high-quality annotations: 1) the noise level of a group of annotators; 2) the inherent ambiguity of an example's class label; and 3) the informativeness of an example to the current classification model. They found that the quality of tags can be improved through eliminating ambiguous examples and noisy annotators. Nguyen-Dinh et al. (2013) proposed two strategies, individual filtering and collaborative filtering, to detect and remove non-serious taggers to increase the accuracy of activity annotation in videos. However, few articles discussed criteria models for examining and evaluating the quality of those selected tags, which passed

the selection step. This is a research gap, and the state of the art in RSS design must present criteria to close the gap. Such issues examined in the next section.

3. Revisiting RSS Research

RSS - The State of the Art

With the growth in the number of products that users can view and purchase online, it is inevitable for users to face an information overload problem as they browse. One solution to this problem is the notion of RSS (Cataltepe et al. 2016; Schafer et al. 1999). RSSs have evolved and become a part of what is known as predictive analytics. RSSs directly or indirectly prompt users of a web service to locate content, products or services relevant to their search. The essence of a recommendation service is underpinned by user behaviour. Gathering and analysing users' data helps improve the accuracy of recommendations, which is then used to guide them to purchase specific products or services (Park et al. 2012). Recommendation systems in particular help e-tailers to 'pitch' the right product to the right consumer at the right time to ultimately increase revenue (Foo et al. 2015).

However, such a collaborative approach has two major flaws: the inadequacy of the user-item matrix and the cold-start problem. The latter occurs if a product is not rated by any users at all: In this case it cannot be recommended. In such situations a content-based approach is more suitable for recommending movies (Uluyagmur et al. 2012; Bergamaschi and Po 2014). Some leading streaming and information sites, such as Netflix, Rotten Tomatoes, and IMDB, prefer the content-based approach for this reason (Bergamaschi & Po, 2014). For example, Netflix uses movie recommendations to encourage users to watch new movies similar to those they have highly rated before (Vig et al. 2009). If a Netflix user has watched many detective movies, the system will recommend other movies that have such tags (Rajaraman and Ullman 2014).

A content-based approach deals with item profile and user profile (Salam 2016; Uluyagmur et al. 2012). An item profile is a collection of records representing critical characteristics of the item. The features of a movie, such as actors, year of release, plot keywords, and genres, which can be linked to a recommendation system, are examples of these characteristics (Rajaraman and Ullman 2014). A user profile is built for each user containing their preferences, which are captured by analysing the similarities between the items that the user has rated. Items can then be recommended by a content-based recommendation system that matches the existing preferences in a user's profile with the features of new items not yet rated by that user (Salam 2016).
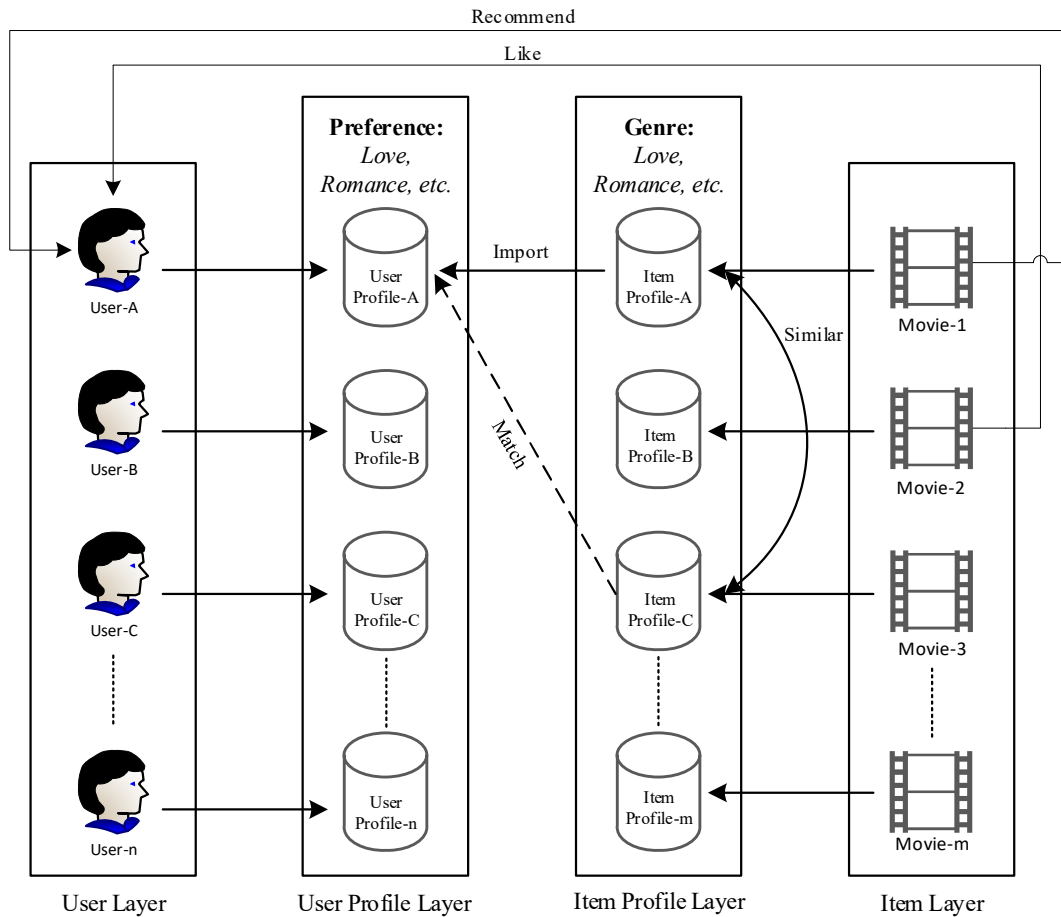
Figure 1. Content-based RSS architecture

Some researchers have found that tags, which are index terms, can be used to describe item features, thereby communicating information about an item to users (Rajaraman and Ullman 2014; Vig et al. 2009). We will therefore review the use of social tagging next. Recommendation systems (RSs) are information tools that aim to predict suggestions or relevant searches or act as a filtering tool for customers. They directly or indirectly prompt the users of a web service to find content, products or services relevant to their search. This recommendation service is fundamentally based on user behaviour. Gathering and analysing such data helps produce more accurate recommendations, which can lead users to purchase the product or service (Park et al. 2012). RSs are particularly useful to e-tailers because they recommend the right product or service to the right consumer at the right time, thus ultimately increasing the e-tailer's business.

Online media services have been quick to adapt to this era of personalisation. These media websites cater to a vast variety of customers. The content they deliver is related to the most popular entertainment source, such as 'movies'. One type of personalised service movie websites use is the RS, which predicts and suggests similar choices depending on a user's browsing history. The content-based recommendation system (CBRS) is one of the most popular RSs, as it identifies matches between user preferences and item descriptions. This approach is useful because it considers active users and can recommend accurately even if there is little data from other user ratings. However, it does have some drawbacks; it cannot recommend items if it cannot access sufficient metadata from the item profile. It also suffers from over-specialisation, which occurs when recommendations are based on selective

7

attributes only (Son and Kim 2017). For example, in choosing a fiction movie, the banner name (e.g. Marvel or DC) is more important than the director, but if more appropriate information on categorisation is not available, the recommendations will be biased. There have to be more categories like actors, characters present, and other identifiers. Collaborative Filtering also has other drawbacks, including sparsity and the cold start problem, and it is vulnerable to fraud and fake profile injections. It degrades as the number of users increases because it becomes unable to produce accurate recommendations; it therefore has to be continuously upgraded (Son and Kim 2017).

Figure 1 is a general architecture of the content-based approach in the instance of a movie recommendation system. The diagrams explain how tags and similar ratings help in recommending a movie to a user. It shows that the more information is collected under a user profile and item profile, the more efficiently this approach produces a match. Research has shown that explanations help increase user satisfaction and acceptance of recommendations (Vig et al. 2009).

Social Tagging Based on Crowd-sourcing

Keeping in mind the drawbacks of both collaborative filtering and content-based approaches in RS, the content-based approach is more effective and useful in our research, as we are introducing a tag-based system supported by a crowdsourcing platform. This type of system can mitigate the drawbacks of CBRS. Currently, many leading movie platforms, such as Netflix, Rotten Tomatoes, and IMDB, are using CRBSs effectively (Bergamaschi and Po 2015). Today users are more sophisticated, and in many cases they generate content themselves. Crowd-sourcing is referred to as collective intelligence in the literature. When more than one person contributes to achieving an objective it creates more value, and collaborative efforts take less time (Sharma et al. 2014). Tags have become more popular on sites such as Flickr, Tumblr, Amazon, Facebook, and Instagram. Users like tags because they are self-explanatory and allow a search to be successfully completed in a shorter period of time.

Crowdsourcing is nothing but filtered user-generated content (UGC). When appropriate high-quality content is filtered it is called 'collective intelligence'.

Tags have various characteristics attached to them; for instance, in Figure 1 the tags explain the features of a movie, e.g. whether the story concerns love or romance. This helps the user decide whether they want to watch the movie (Vig et al. 2009). It is tedious for e-tailers to have a separate staff ('army') to generate tags and keep them up to date. The reason for calling such staff an army is that online content changes daily, and the trends, types of movies, and genres change rapidly; it is also difficult to continuously update the metadata. Crowdsourcing the tags encourages end users to complete this task themselves and is thus more efficient than completing this work in-house (Zheng and Quidan 2011; Vig et al. 2009). Many researchers have suggested using collective intelligence as a tool to annotate and use systems such as Amazon Mechanic Turk to create more tags in less time and at a lower cost (Nguyen-Dinh et al., 2013; Hsueh et al. 2009). Because one does not have to be an expert to create tags, crowdsourcing can be a perfect means of increasing users' trust in RSs and to understand users' perspectives on presentation, explanation, and priority on websites (Berkovsky et al. 2017; Vig et al. 2009).

It is worth mentioning that a film's features, such as its genre and plot keywords, can be described by tags (Rajaraman and Ullman 2014). When websites assign tagging tasks to internal staff, it increases their workload, so some authors have suggested adopting crowd-sourcing to perform tagging (Nguyen-Dinh et al. 2013; Hsueh et al. 2009). Smaller e-tailers can recruit external annotators through Internet services (e.g., Amazon Mechanical Turk, abbreviated as MTurk) to allow multiple tagging tasks to be done in bulk with fast completion rates and low overall costs (Hsueh et al. 2009).

Content-based Recommendation Systems

The predominant view in the industry currently is that recommendation systems can facilitate customers' purchasing processes and make a positive impact on the users regarding the experience of making online purchases (Venkateswari and Suresh 2011; Swathi and Reddy 2014). In the online movie sales industry, unlike the collaborative approach, the content-based approach is not impeded by the problems of sparse user-item matrices and cold starts (Uluyagmur et al. 2012). It is thus more reliant on user information, such as user preferences, and item information such as ratings. It recommends items which correlate with the interests demonstrated by users in the past. Even if a movie has not been rated by any users, so long as the movie has sufficient movie information, it can be recommended to users who have similar preferences. The extent of sales diversity is then increased by allowing consumers to access more new and niche products among seemingly endless alternatives (Fleder and Hosanagar 2009).

Social Tagging Based on Crowd-sourcing

Using crowd-sourcing tools such as MTurk to generate tags allows multiple tagging tasks to be done in bulk with fast completion rates (Hsueh et al. 2009). For start-ups and de-novo firms entering a digital marketplace, it provides several benefits, such as broader access to specialised skills, shorter product development cycles, more flexible and faster-hiring processes, as well as relatively low costs (Knop et al. 2017). Moreover, the empirical results of Nguyen-Dinh et al. (2013) showed that the quality of a final annotation set generated by MTurk was comparable to that produced by experts and that it was very accurate (76% to 92%). Overall, the more tags an item has, the more features of that item that can be captured and displayed to users. Accordingly, the more user preferences that can be uncovered, expressed and matched correspondingly, the more accurate recommendations will become. Crowdsourcing is thus essential in order to generate more tags faster and at lower cost.

Shortcomings of Content-based RSSs

The effectiveness of CBRSs depends on the metadata they use, so data categorisation is crucial to produce accurate suggestions. Insufficient information in item profiles is a major concern because it leads to biased choices being recommended to users (Son and Kim 2017).

With respect to crowdsourcing and tagging, the willingness of users of movie websites to contribute to tagging is the most critical element of crowdsourcing. How users interact with systems involves three dimensions of trust: dispositional trust dealing with cultural situational trust is more about the work and demographic factors situational trust dealing with intricate tasks involving systems; and learned trust, which is established when a user interacts with a systems and builds experience with it (Berkovsky et al. 2017). The workers being untrained will also affect the accuracy of the tags they create, as well as explanations associated with

and presentation of the data. It is therefore critical to establish criteria to maintain the user-system trust for tagging items and combining those elements with the CBRS.

While crowdsourcing may be a useful means of collecting real-time data, it also presents the problem of being incompatible with certain systems, making it difficult to combine real-time data and complement it simultaneously (Gao et al. 2011). Identifying a criterion for acceptable tags is a persistent issue, which requires developing a framework which will explain specific criteria and rules. Eliminating the noise level and ambiguous tags are also essential (Nguyen-Dinh et al. 2013; Milicevic et al. 2010). One of the main issues raised by the online recruitment of taggers is that these workers are not specifically trained for tagging and the work they do cannot be screened for quality. Therefore, the tags they produce may not be of sufficiently high quality (Nguyen-Dinh et al. 2013; Hsueh et al. 2009).

4. Towards an RSS Research Agenda

To recap, it is therefore timely to consider state-of-the-art strategies, approaches and case studies of RSS that may be adopted in global electronic markets. Moving forward with an RSS agenda requires synthesising findings which can be prescribed as design principles for CIST.

The current state of content-based recommendations can be improved by increasing the trustworthiness of both user and item profiles. Although tags can improve the functionality of RSs by visually depicting star ratings, they can also enrich a recommendation system's features. However, gaining *accuracy* and *trust* for such user-generated content is complex and not assured. Tags are effective for depicting personalised recommendations, but *information overload* must be avoided by limiting the number of tags. Lead users are willing to generate tags, but novice users are often not completely comfortable doing so.

A synthesis of RSS research also suggests that more *personalised suggestions* are feasible if tags are created based on highly discriminant values. RSs must foster trust in online shopping—the suggestions for presentation, explanation and prioritisation are currently effective, but trustworthiness and accuracy are of utmost importance. Finally, concerns remain regarding the security and privacy of RSs and the CIST approach. Although every e-commerce website presents clear agreements containing its privacy and security terms, this has not completely eliminated users' fears of violations. For instance, it is well known that IP addresses still leak users' private information related to their purchasing and tagging preferences. Hence, finding effective solutions and improvements for CIST to avoid invasions of privacy through IP addresses is a necessary design feature for CIST.

Based on the above discussion, the three significant design challenges that remain are: the trust and accuracy of UGC, personalised suggestions and information overload. For CIST to avoid these problems and improve the functionality CBRSs, we offer the following three recommendations.

Clustering Tags to avoid Confusion

One of the most important concerns raised by IT developers and user groups was information overload. CIST relies on user-generated tags, the number of which grows continuously because the tags contain the personally preferred words of each user. It is inevitable that these tags will include synonyms, vernacular words, confusing meanings, etc. For example, a

movie such as *The Avengers* may have many tags, such as *superpower*, *supernatural*, *mission*, *objective*, *pursuit*, etc. Similarly, *Justice League* could have *woman-power*, *strong*, *superman*, etc. The main problem for the recommendation engine is that the movies must be related to the content that is suggested. This can be solved by 'clustering the tags', which groups similar movies with the most common tags together.

Randomisation and personalisation of tags are also common, especially in UGC. This leads to information overload, a lack of data space, and semantic obstacles. Three popular algorithms can be used to resolve these problems: min-max similarity *k*-means, tag clustering based on semantic analysis and latent min-max similarity *k*-means (Yang and Wang 2017).

The 'work around' option here can be 'tag clustering based on semantic analysis', because colloquial words and synonyms can be bundled for better results. Currently, CIST is designed to consider only online movie selling platforms. Hence, a film's features are the most important element of a content-based RSS. In other words, the more item profiles on which an RSS is built, the better the expected result.

A Five-Criteria Framework for Building User-System Trust

Commercial recommendation engines owe their success to users to a great extent. It is a two-way information exchange: the more exceptional the data offered, the more time customers will spend reviewing it. However, success also depends on certain parameters, such as freshness of content, precise suggestions, and, most importantly, promising value (Berkovsky et al. 2017). Modern users need personalised suggestions, more data to filter and a hassle-free website. Our data analysis established that content quality is directly proportionate to an e-tailer's' trustworthiness, so we extracted some key user experience (UX) factors from prior research and added two more criteria to broadly define user-system trust: accuracy, trustworthiness, presentation, explanation and priority. Figure 2 below illustrates the criteria for establishing a user-system trust and ultimately encouraging users to contribute to tagging and provide more functionality on a website.
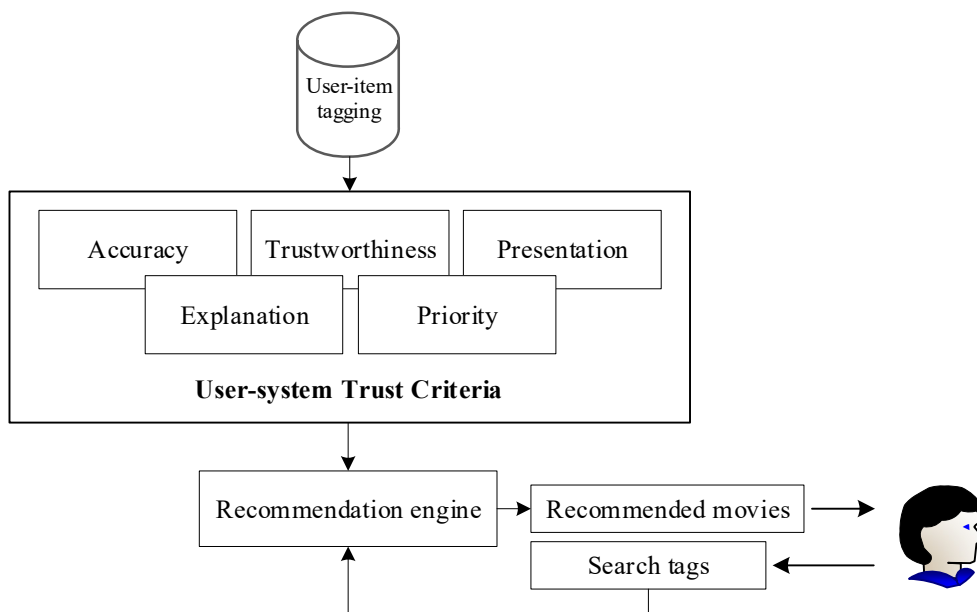

Figure 2. An architecture for building user-system trust

IT developers are aware that users will have little domain expertise about some movies on their recommended list. In such cases, an RS must support decision-making while also keeping users engaged and making more functionality available to aid in decisions. Hence, RSs are more than merely a means of pushing users to make decisions. Overall, accuracy and trust are of paramount importance in developing a CIST because the main resource for tags is users themselves, making these criteria of utmost value in the effort to maintain users' interest.

A Clear Process for Distinguishing and Displaying Tags

To address the issue of personalised suggestions and to encourage users to engage more, the CIST approach must consider which tags will appear most often. Therefore, to avoid confusion, a simple method of dividing a film's 'features' into primary and secondary tags is essential. In Figure 3 below, the primary tags characterise the main theme of the film. The primary tag is different from the 'genre' of a movie, which explains the category to which the movie belongs. For example, the film *The Avengers* belongs to the sci-fi genre, but the word *superhero* could be its 'primary tag'. All other plot keywords or film features that describe the storyline or themes are 'secondary tags'.

5. Overview of the Special Issue

RSS research has revealed broader aspects of designing impactful recommendations such as crowdsourcing, tags, and RS, which, when combined, elicited a positive response. The goal of RSS research must be to understand the acceptance and feasibility of various architectures. According to Affordance Theory (Volkoff and Strong 2017), an 'affordance' allows a stakeholder to perceive the characteristics and features of a system (such as an RS) in terms of how it can be used. More specifically, functional affordances refer to UXs in that a user can allow an RS, if it affords them, to guide them by providing suggestions for restaurants, to enable the use of such recommendations by providing directions, best routes, etc., or facilitate making reservations or inviting other guests to the venue.

In that sense the three articles following this preface that comprise the Special Issue take different perspectives in examining the affordances of RSS. In no particular order, the first by Laisong Kang, Shifeng Liu, Daqing Gong and Mincong Tang on the topic of "A personalized point-of-interest recommendation system for O2O commerce" prescribe a need for seamless service experiences between online commerce and offline bricks-and-mortar commerce. This class of RS using social-tagging is closely related to location-based social networks (LBSNs), which incorporate mobility patterns and human social ties. The authors believe that personalized point-of-interest (POI) recommendations are therefore crucial for O2O commerce in LBSNs; such recommendations not only help users explore new venues but also enable many innovative location-based services to spawn from this personalised understanding of users and offerings. The primary contribution of their approach is that it may be applied to conduct online promotion and purchasing to drive offline marketing and consumption.

The second paper by Payam Hanafizadeh, Mahdi Barkhordari Firouzabadi and Khuong Minh Vu on the subject of "Insight monetization intermediary platform using recommender systems" introduces the notion of data monetization. Specifically, it addresses the question of whether we can provide a model by which experts can monetize their

knowledge and expertise. The authors state that at its core, their proposed RS approach accepts an expectation as an input which attends to elicit informational needs of expert, validates the expectation by the participation of professionals who contribute to the platform by using real-time recommendations of assisting data and information, processes the validated input using data gathered by data providers, and creates value in forms of an insight which is sold to a potential buyer. Such collaborative filtering has the added advantage of providing submission and validation of expectations, access to data, and selling insights as a form of explanatory power for recommendations or suggestions.

Finally, the paper by Huosong Xia, Xiang Wei, Wuyue An, Zuopeng Justin Zhang and Zelin Sun entitled "Design of electronic-commerce recommendation systems based on outlier mining" applies collaborative filtering recommendation theory in an exceptional manner. The authors justifiably claim that whereas prior studies mostly consider outliers as noise data and eliminate them, resulting in the loss of outlier knowledge, their paper develops a new e-commerce recommender model from the perspective of outlier knowledge management. Specifically, they apply outlier data mining and integrate local outlier coefficients into the recommendation algorithm. The practical contribution of their approach is that it performs better than the traditional recommendation systems based on collaborative filtering. They conclude that this can effectively improve the quality of recommendation, enhance customer satisfaction and loyalty, and create potential benefits for the business.

Viewed as a whole, the three articles as well as the numerous submissions received, we may conclude that the state of RSS research is diverse and innovative. As an agenda for future RSS research, we suggest that it would be fruitful to understand the experience and performance of current approaches. Insights into alternative algorithms to code a recommendation or suggestion will aid our understanding of the design choices that developers of RSS are confronted with. Solutions for resolving security and privacy concerns about CIST must also be investigated. Netflix's *The Social Dilemma*, for example, has brought to the attention of popular culture, the dark side of algorithms and nudging human behaviour in what may seem manipulative. A host of techno-moral and legal issues remain to be addressed. There is a critical and continuing need for RSS research to investigate these socio-technical issues.

Acknowledgements

References

Bergamaschi S., & Po L. (2015). Comparing LDA and LSA Topic Models for Content-Based Movie Recommendation Systems. In: Monfort V., Krempels KH. (eds) Web Information Systems and Technologies. WEBIST 2014. Lecture Notes in Business Information Processing, vol 226. Springer, Cham. https://doi.org/10.1007/978-3-319-27030-2_16

Berkovsky, S., Taib, R., & Conway, D. (2017, March). How to recommend? User trust factors in movie recommender systems. In Proceedings of the 22nd International Conference on Intelligent User Interfaces (pp. 287–300), ACM. https://doi.org/10.1145/3025171.3025209

Cataltepe, Z., Uluyağmur, M., & Tayfur, E. (2016). Feature selection for movie recommendation. *Turkish Journal of Electrical Engineering & Computer Sciences*, *24*(3), 833–848. https://doi:10.3906/elk-1303-189

Feng, H., Tian, J., Wang, H. J., & Li, M. (2015). Personalized recommendations based on time-weighted overlapping community detection. *Information & Management*, *52*(7), 789–800. https://doi.org/10.1016/j.im.2015.02.004

Fleder, D., & Hosanagar, K. (2009). Blockbuster culture's next rise or fall: The impact of recommender systems on sales diversity. *Management Science*, *55*(5), 697–712. https://doi.org/10.1287/mnsc.1080.0974

Foo, S., Sharma, R. & Chua, A. (2015). Knowledge Management Tools and Techniques, (3ʳᵈ edition, digital version), Prentice-Hall, Singapore.

Gao, H., Barbier, G., & Goolsby, R. (2011, May-June). Harnessing the Crowdsourcing Power of Social Media for Disaster Relief. *IEEE Intelligent Systems*, *26*(3), 10–14. https://doi.org/10.1109/MIS.2011.52

Haren, R. V. (2017). Crowdsourcing feedback. *Literacy Learning: the Middle Years*, 25(1), 7–15. Retrieved from https://www.alea.edu.au/documents/item/1468. Accessed 1 December 2020.

Heimbach, I., Gottschlich, J., & Hinz, O. (2015). The value of user's Facebook profile data for product recommendation generation. *Electronic Markets*, *25*(2), 125–138. https://doi.org/10.1007/s12525-015-0187-9

Hsu, P. Y., Lei, H. T., Huang, S. H., Liao, T. H., Lo, Y. C., & Lo, C. C. (2018). Effects of sentiment on recommendations in social network. *Electronic Markets*, *28*(1), 1–10. https://doi.org/10.1007/s12525-018-0314-5

Hsueh, P., Melville, P., & Sindhwani, V. (2009). Data Quality from Crowdsourcing: A Study of Annotation Selection Criteria. Proceedings of the NAACL HLT 2009 Workshop on Active Learning for Natural Language Processing (pp. 27–35). Boulder, Colorado.

Hwangbo, H., Kim, Y. S., & Cha, K. J. (2018). Recommendation system development for fashion retail e-commerce. *Electronic Commerce Research and Applications*, *28*, 94–101. https://doi.org/10.1016/j.elerap.2018.01.012

Kang, L., Liu, S., Gong, D., & Tang, M. (2020). A personalized point-of-interest recommendation system for O2O commerce. *Electronic Markets*, 1–15. https://doi.org/10.1007/s12525-020-00416-5

Khan, Z. A., Chaudhary, N. I., & Zubair, S. (2019). Fractional stochastic gradient descent for recommender systems. *Electronic Markets*, *29*(2), 275–285. https://doi.org/10.1007/s12525-018-0297-2

Knop, N., Durward, D., & Blohm, I. (2017). How to Design an Internal Crowdsourcing System. Proceedings of the 38th International Conference on Information Systems (ICIS). Seoul. Retrieved from: https://www.alexandria.unisg.ch/publications/252020. Accessed 15 January 2021.

Köhler, S., Wöhner, T., & Peters, R. (2016). The impact of consumer preferences on the accuracy of collaborative filtering recommender systems. *Electronic Markets*, *26*(4), 369–379. https://doi.org/10.1007/s12525-016-0232-3

Milicevic, A. K., Nanopoulos, A., & Ivanovic, M. (2010, March). Social tagging in recommender systems: a survey of the state-of-the-art and possible extensions. *Artificial Intelligence Review*, *33*(3), 187–209. https://doi.org/10.1007/s10462-009-9153-2

Nguyen-Dinh, L., Waldburger, C., Roggen, D., & Tröster, G. (2013). Tagging Human Activities in Video by Crowdsourcing. Proceedings of the 3rd ACM conference on International conference on multimedia retrieval (pp. 263–270). Dallas: ICMR.

Hanafizadeh, P., Firouzabadi, M. B., & Vu, K. M. (2021). Insight monetization intermediary platform using recommender systems. *Electronic Markets*, 1–25. https://doi.org/10.1007/s12525-020-00449-w

Park, D. H., Kim, H. K., Choy, I. Y., & Kim, J. K. (2012). A literature review and classification of recommender systems research. *Expert Systems with Applications*, *39*(11), 10059–10072. https://doi.org/10.1016/j.eswa.2012.02.038

Rajaraman, A., & Ullman, J. D. (2014). Mining of Massive Datasets. Cambridge: Cambridge University Press.

Salam, S. N. Z. (2016). Evaluating Prediction Accuracy For Collaborative Filtering Algorithms In Recommender Systems. Unpublished Report of Royal Institute of Technology School Of Computer Science And Communication, Stockholm, Sweden. Retrieved from: https://kth.diva-portal.org/smash/get/diva2:927356/FULLTEXT01.pdf. Accessed 10 December 2020.

Schafer, J. B., Konstan, J., & Riedl, J. (1999, November). Recommender systems in e-commerce. Proceedings of the 1st ACM Conference on Electronic Commerce (pp. 158–166). ACM.

Sharma, R., Soe, K. M., & Balasubramaniam, D. (2014). Case studies on the exploitation of crowd-sourcing with Web 2.0 functionalities. *International Journal of Electronic Business*, *11*(4), 384–408. https://doi.org/10.1504/IJEB.2014.065839

Sharma, R., & Kale, R. (2018). Design of Back-End of Recommendation Systems Using Collective Intelligence Social Tagging. Proceedings of the 18th International Conference on Electronic Business pp 194 - 210. December 2-6. Guilin China. https://aisel.aisnet.org/iceb2018/56

Son, J., & Kim, S. B. (2017). Content-based filtering for recommender systems using multi-attribute networks. *Expert Systems with Applications*, *89*, 404–412. https://doi.org/10.1016/j.eswa.2017.08.008

Swathi, V., & Reddy, M. S. (2014). Music Recommendation System Using Association Rules. International Journal of Technology Enhancements and Emerging Engineering Research, 2(7), 31-34. http://www.ijteee.org/final-print/july2014/Music-Recommendation-System-Using-Association-Rules.pdf. Accessed 15 January 2021.

Uluyagmur, M., Cataltepe, Z., & Tayfur, E. (2012). Content-Based Movie Recommendation Using Different Feature Sets. Proceedings of the International Conference on Machine Learning and Data Analysis (ICMLDA'12), San Francisco, CA, USA. Hong Kong: IAENG. pp. 517–521.

Venkateswari, S., & Suresh, R. M. (2011). Association Rule Mining in E-commerce: A Survey. *International Journal of Engineering Science and Technology*, *3*(4), 3086–3089.

Vig, J., Sen, S., & Riedl, J. (2009). Tagsplanations: explaining recommendations using tags. Proceedings of the 14th International Conference on Intelligent User Interfaces (pp. 47–56). Florida: ACM. https://doi.org/10.1145/1502650.1502661

Wang, Y., & Sharma, R. (2018). Design of Front-End for Recommendation Systems: Towards a Hybrid Architecture. Proceedings of the 18th International Conference on Electronic Business pp 211–220. December 2–6. Guilin China. https://aisel.aisnet.org/iceb2018/80

Xia, H., Wei, X., An, W., Zhang, Z. J., & Sun, Z. (2020). Design of electronic-commerce recommendation systems based on outlier mining. *Electronic Markets*, 1–17. https://doi.org/10.1007/s12525-020-00435-2

Yang, J., & Wang, J. (2017, May 11). Tag clustering algorithm LMMSK: Improved K-means algorithm based on latent semantic analysis. *Journal of Systems Engineering and Electronics*, *28*(2), 374–384. https://doi.org/10.21629/JSEE.2017.02.18

Zihayat, M., Ayanso, A., Zhao, X., Davoudi, H., & An, A. (2019). A utility-based news recommender system. *Decision Support Systems*, *117*, 14–27. https://doi.org/10.1016/j.dss.2018.12.001

Zheng, N., & Quidan, L. (2011). A recommender system based on tag and time information for social tagging systems. *Experts Systems with Applications*, *38*, 4575–4587. https://doi.org/10.1016/j.eswa.2010.09.131