PERSONALIZED QUESTION-ANSWERING MOBILE SYSTEM

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Abstract: Mobile messaging is an integral and vital part of the mobile industry and contributes significantly to worldwide total mobile service revenues. In today's competitive world, differentiation is a significant factor in the success of the business communication. SMS (Short Message Service) provides a powerful vehicle for service differentiation. What is missing, however, is the availability of personalized SMS messages. In particular, the exploitation of user profile information allows a selection and content delivery that meets preferences and interests for the individual. Personalization of mobile messages is important in today's service-oriented society, and has proven to be crucial for the acceptance of services provided by the mobile telecommunication networks. In this paper we focus on user profile description and the mechanism for delivering the relevant information to the mobile user in accordance with his/her profile.

Introduction

This paper represents results of our further research in the text data mining and the natural language processing areas [1-6] restricted by mobile phone text-based SMS messaging. SMS actually accounts for approximately 75% to 80% of non-voice service revenues worldwide [7]. Last year we represented the Question-Answering Mobile ENgine (QAMEN) [6], which is able to support now its mobile users with personalized situation-aware services. Moreover, QAMEN frees users to have an expensive mobile phone with a web browser. Internet connections from mobile devices remain expensive.

Let us distinguish four different types of Mobile Message (MM):

1. **Person↔QAMEN MM** (MM_{PS}) wherein QAMEN receives user's search query and immediately sends back a text message with the carefully selected result. User's Profile (UP) might be involved to meet the user's demands for searching.

2. **QAMEN (UP)→Person MM** (MM_{SUP}) when user describes in User's Profile <u>what kind of information</u> he/she wants to receive <u>what kind of events</u> need to be taken into account to generate the MM_{SUP}, and <u>when</u> MM_{SUP} should be sent to user. QAMEN, in accordance with those descriptions, generates replies and sends them to user. For example, user wants to know "*the weather in Doncaster on the day of the horse races*".

3. **External MM** (MM_E) when MM_E is sent by some external organisation e.g. "*dental appointment reminder*".

4. **Person-to-Person MM** (MM_{PP}) is ordinary MM when one person sends MM to another person and QAMEN is not involved.

Only MM_{PS} and MM_{SUP} will be considered in this paper.

The success of using MM (MM without index means MM_{PP} and MM_E) is clearly described by Metcalfe's Law [8] – "*The usefulness, or utility of a network equals the square of the number of users*" i.e. put simply, the more users on a network, the more useful and successful it is. This is clearly demonstrated by the success of national SMS interworking – national SMS traffic grew nearly eight times in nine months once the four UK networks were fully interconnected [9].

Mobile question answering differs from standard information retrieval methods. First, it needs to retrieve specific fact information rather than whole documents. Secon, it should select among the found facts the shortest and appropriate fact to meet the 160 characters requirement. In short what a user really wants is a precise answer to a question. For instance, given the question *"When Alexander Pushkin was born?"*, a user wants to get the answer *"In 1799"*, but not to read through lots of documents that content the words *"Alexander"*, *"Pushkin"* and *"born"*. QAMEN takes MM_{PS} as input, classifies it, transforms it into enquiry taking into account UP and current events. When a set of relevant facts is retrieved, the QAMEN extracts from them the most appropriate one and sends it to user's mobile. Search technologies of QAMEN are evolving to provide users with appropriate results despite of unstructured web content. The reasons for web content data remaining unstructured are:

- Data comes from multiple unstructured repositories (file servers, document management systems, intranet sites, internet sites, etc.).

- Data in unstructured documents is of widely varying quality.

- Different types of unstructured data vary greatly from area to area.

That is why processing of personalized MM_{PS} has to take into account **Who** uses MM_{PS} and in **What area**.

Who uses MM and How often?

According to a recent BBC report, SMS has taken the lead as the most popular function for a mobile phone amongst young people. Some **80%** of people under **25** would rather send an MM than make a call, but the number reduces to **14%** among those aged **55 years** and above. When considering gendered differences, the data shows that while 36% of the men reported daily use, more than 40% of the women said that they send MM on a daily basis. The mean number of words per message for men was 5.54. By contrast, the mean number was 6.95 words per MM for women.. Using abbreviations in their MM text-messages: F = 89%; M = 57%.

MM survey

A survey was undertaken by SMS text-messaging company, KAPOW [10]. A summary of survey findings are presented below:

- **How many MM do you receive per day?** (a) None – 9%; (b) 1-5 – 59%; (c) 5-10 – 17%; (d) +10 – 15%.

- **Have you ever received MM from the following?** (a) Mobile-phone operators – 45%; (b) Mobile-phone resellers – 17%; (c) Adult-content providers – 4%; (d) Doctors/dentists (for appointments etc) – 3%; (e) Banks – 10%; (f) Charities – 1%; (g) Bars & Clubs – 9%; (h) Other – 11%.

- **Has MM helped you to remember a meeting, work commitment or any other appointment?** (a) Yes – 65%; (b) No– 35%.

- **If you opt to receive sales information how do you prefer to receive it?** (a) via phone call – 3%; (b) via e-mail – 62%; (c) via MM – **16%**; (d) via instant messaging – 1%; (e) via post – 18%.

- **For which service would receiving MM be most useful?** (a) Football scores – 14% (b) Confirmation of appointments – 28% (c) Entertainment services such as ringtones and logos etc – 4% (d) Bank account balances – 18% (e) Insurance quotes/confirmation – 4% (f) Bar and club promotions – 6% (g) Travel information – 19% (h) Other 7%.

- **Do you agree that MM will become a much bigger part of our working and domestic lives over the coming years?**(a) Yes – 87% (b) No– 13%.

- **84%** of users expect a MM_D response in **five minutes**.

In What area is MM used?

MM is being used in increasingly sophisticated ways, and is fast becoming a huge money earner for operators as well as a tool for businesses. Growth in the MM market is directed towards the area of value-added MM services.

These range from downloads of simple ring tones to news and sports updates. MM is increasingly also being used for finance based transactions. Some might say internet businesses could even consider the technology a means to accept micro-payments for content and services. With premium-priced MM customers simply find something they wish to purchase from a website, and then send a text message to a specified number, including a product code, and moments later a reply is received with an access code. Once a code is used for a purchase, via the phone, a charge is debited on a customer's phone bill or - in the case of a pre-paid mobile phone - directly.

MM is a low-cost communication exchange method that is relatively stable. For example, there is an increased use of one-way outbound **alert notifications for crisis** because MM is more secure, it's faster, and it enables users to reach a wide array of citizens and alert them to pending dangers.

MM is an ideal way for advertisers to reach target markets and establish a one-to-one relationship with the consumer, which is every advertiser's ultimate aim. For example, weather application is defined as personalized, localized weather prediction according to user location, personal profile. Weather related advertisement system knows how to match the right add to the right weather where the advertisement is most effective. For example, implementing a decision to start a soft drink campaign when the temperature approaches, 32°C / 90°F according to user location (if the user is close to the beach and experiencing higher levels of effective temp he will enjoy different add in different temperatures). Such approaches would help the advertiser to optimise its advertising campaign.

As for MM_{PS} **34%** users use MM_{PS} for *news and sport*, **25%** - for *map and location*, **21%** to *search* some data, and **20%** for *checking weather* [11].

The most usable areas for MM_E are meeting reminder, sales management, work order, system alert, appointment confirmation, job dispatch, workflow management, information update, payment reminder, customer notification, marketing message, stock and fund quotes, travel information, local weather.

Intelligent MM

The MM has quickly become a boon to the business world as well as to consumers, but so far developers are only scratching the surface of its potential business usage. To fully realize the benefits of MM, businesses must integrate it into their business processes, and into their existing IT systems. When MM is used as part of an overall business process that interacts with consumers, for example, then the enterprise has moved from traditional MM (TMM) to intelligent MM (IMM).

IMM may be differentiated from TMM in these ways [12]:

- The service application is typically a rich enterprise application with business process data, compared to "lightweight" application such as queries for TMM.

- The transaction is "pushed" by the service application, compared to the mobile user "pull" method of TMM.

- An IMM is typically interactive between the service application and the user, whereas TMM is typically a one-way action.

- An IMM allows the user to respond to a message with a "one button" response, where TMM requires the keying in of a response message.

- Authentication of the user with the server application is embedded and automatic to IMM, whereas TMM may be based upon the mobile phone number, plus codes that must be entered by the user.

We have some experience of IMM implementation. 2ergo launched of its MultiSend messaging suite, a range of products that will introduce a new level of interaction and engagement between organisations and their target audience [13]. Design and build a scalable MultiSend solution that would be capable of transmitting up to 40 million messages per month (SMS, MMS and Email). Companies that have already signed up for the MultiSend suite include the internationally renowned travel company Thomas Cook, the major UK car rental company, National Car Rental, and the trans-national publishers, Reed Business International. The suite gives

organisations the capability to automate many of their regular outbound communications and to engage in one-to-one dialogue with their target audience, not only to encourage rapid responses, but to also conclude many forms of business transactions. For example, appointment and payment reminders, membership and subscription renewals, or marketing campaigns and customer surveys.

The central question to be addressed by this paper, however, is how to provide the response to a personalized user's MM (MM_{PS} **and** MM_{SUP}). Let us underline that in this paper we consider the precise situation when an MM is sent to the QAMEN i.e. to the artificial system, but not to another person (MM_{PP}). It is important to notice because there is a significant difference between MM_{PS}, which is very similar to internet enquiry, and MM_{PP}.

Difference between MM_{PS} and standard text

There are several elements that lead us to think that MM_{PS} is more like speaking than writing. Firstly, MM_{PS} is intended for immediate response. Secondly, as with most spoken language MM_{PS} makes the assumption of informality. In addition, as a rule, MM_{PS} is ungrammatical:

- Dropping '?' at the end of MM_{PS}.

- Not using any punctuation at all.

- Dispensing with the verb e.g. "*2ergo address*" instead of "*What is 2ergo address?*", or "*Where is 2ergo located?*". Specific questions are used as a rule to find out date: "*When Pushkin born*", or place: "*When Pushkin born*".

- Deletion of articles.

In the next sections a definition of UP is given and elements of UP are described.

User Profile

Various, quite different definition of personalization can be found in [15] and [16]. However, throughout this paper the definition from [14] is used:

"Personalization of a service is the ability to allow a user **U** to adapt, or produce, a service **A** to fit user **U**'s particular needs, and that after such personalization, all subsequent service rendering by service **A** towards user **U** is changed accordingly."

Personalization is provided by the user by means of the user profile (UP). A UP is a group of settings that define how QAMEN is set up for a particular user. Simply stated, the UP serves as a bridge between the generic queries from the diverse users and the heterogeneous data. The main task of UP creation is to establish UP structure. There are, as yet, no standards for representing these, because there is no general agreement on what UP should contain. That is why we were free to offer our vision of UP structure. The UP is uniquely identified by a mobile phone number. Its content composes of three parts: (1) a collection of personal data, (2) set of frames representing the user demands, and (3) history activities. The history activities of the user is a crucial feature in order to automate UP improving process i.e. provide self-improved UP. In this paper we focus solely on the description of user demands and the process of the self-improving UP is not therefore considered.

The personal data of the user consists of the following items:

- Mobile No and Password;

- First Name, Last Name, Date of Birth, and Gender.

User's requirement to MM_{PS} and MM_{SUP} is represented by Demand's Frame (DF), i.e. by DF_{PS} and DF_{SUP} accordingly. DF should take into account the fact that different users may expect different answers to the same query and the same user for the same query may expect different answers in different periods of time. That is why the possibility to define the desire date and time in UP becomes relevant. DF is defined by a Type (DFT) and a set of attributes.

The general form of a DF is the following:

DFT<AI>,<VAI><Priority>[Value][City Country]<Web Site><Date and/or Time><Event><SMS>,

where:

- **DFT** is a type of DF and will be described in the next section;
- **AI** stands for area of interest and is represented by the first level of *Areas of Interests* tree (see Figure 1);
- **VAI** is the value that is associated with AI;
- **Priority** has just one meaning *Default* and can be used only in one DF_{PS};
- **[Value]** and **[City Country]** represent the DF slots. They might be predefined during UP creation, or be empty;
- **Web Site** allows the user to define the desirable site for searching;
- **Date** and/or **Time** is used to set require date and/or time only in DF_{SUP}, i.e. user can specify the delivery date and/or for incoming messages;
- **Event** indicates that list of events for current day (see Figure 2) must be involved for both MM_{PS} and MM_{SUP} modification;
- **SMS** is used only in DF_{SUP} and designate that MM_{SUP} must be created (if **Event** is mentioned), QAMEN should search for reply, and send the found response to user.

The general requirements to UP creation are:

- Only one **Default** DF might be used in DF_{PS};
- Duplication of DFT is not allowed in DF_{PS}, but there is no any restriction in using the same DFT in DF_{SUP};
- Empty MM_{PS} might be used only for **Default** DF_{PS}. For example, if DF_{PS} is described as:

Weather [Default] [Varna Bulgaria]

it would be enough for user just to send empty MM_{PS} to receive the proper information about weather in Varna.

Business	Entertainment	Finance	Knowledge	Health	Location	News	Politics	Price	Sport	Weather
Farm	Music	Insurance	Glossary	Pain relief	Company	World	Local	Computer	Football	Football
Industry	Cinema	Mortgage	Omit	Heart disease	Organisation	U.K.	International	Mobile	Rugby	Rugby
Finance	Theatre	Solicitor		Overweight	Pub	Business	Election	Furniture	Tennis	Tennis
Hotel	Show	Investment		Cancer	Hotel	Sci/Tech	Omit	Equipment	Golf	Golf
Restaurant	Omit	Bank		Back pain	Restaurant	Sport		Holiday	Cricket	Cricket
Shop		Stock		Omit	Cinema	Entertainment		Medication	Racing	Racing
Omit		Omit			Shop	Health		Used Car	Sailing	Sailing
					Night Club	Omit		New Car	Olympics	Omit
					Casino			Omit	Snooker	
					Theatre				Omit	
					Omit					

Figure 1. Areas of Interests

The described structure of UP may change in the future but unless some of the requirements were missing it seems the existing choice is simple and flexible enough that no big change should be needed in the future. UP can be easily created and updated via the web-based interface (see Figure 3).

Keywords and Short Code of DFT

QAMEN is an SMS oriented engine which allows the user to enter requests in the shortest form, which **provides the user a better response to their enquiry**. For example, instead of entering the full enquiry: *"I'm looking for pizza hut restaurants in Preston"* it's enough to type in: *"Pizza hut Preston"*, or instead of *"What is the address of 2ergo?"* better to enter the request *"2ergo address"*. Only specific questions *When* and *Where* should be used e.g. *"When Pushkin was born?"* and *"Where Pushkin was born?"* but not *"Who is Pushkin?"* because you should enter just *"Pushkin"* to received the proper answer.

There are several **Keywords** and **Key symbols** (short code of DFT), which significantly simplify the request presentation. The selection of these keywords and DFT was initiated by areas of interests (see Figure 1). The following keywords and key symbols should be used as DFT:

- By default, i.e. for ANY USER, any request without DFT is considered by QAMEN as a request for searching General Knowledge. Firstly, QAMEN is searching in the Local Knowledge Base (**LKB**), and then, if the result of searching was not success, QAMEN is searching in the Internet. If (for any reason) searching in the LKB need to be omitted DFT **q** should be used e.g. **q** *British Civil War* instead of **British Civil War.**
- **Weather** (or simply **w**), followed by the location. Usually a city name will be enough, but to avoid an ambiguity better to include the country as well e.g. *weather Plymouth UK* or (**w** *Plymouth UK*).
- **Location** (or simply **a**), followed by shop's (or organisation's) name, city and country (just in case to avoid an ambiguity) e.g. **a** *used car Preston*, or **a** *HSBC Nice France*, or **a** *opera London*, or **a** *NINO's Rawtenstall*) provides an **Address** and/or **Telephone**.
- **News** (or simply **n**) followed by the searchable values e.g. **n** *Manchester United*, or **n** *Tony Blair*.
- **Sport** (or simply **s**) followed by the searchable values e.g. **s** *tennis Sharapova*.
- **Price** (or simply **p**), followed by the product description e.g. **p** *coffee maker*, or **p** *Dell XPS*.
- **Finance** (or simply **f**), followed by company's name e.g. **f** *2ergo plc*.
- To have result of searching in specific file type request should starts with searchable values followed by space, semicolon and file type e.g. *David Traynor* **:pdf**.
- To provide searching within the local site request should start with searchable values followed by the www address e.g. *David Traynor* www.2ergo.com.
- **Population**, followed by the country e.g. *population of UK (*or *population UK)*.
- **Evaluation of Mathematical Expressions** e.g. *sqrt(34^7/356)*sin(pi/2.3)*.
- **Currency Conversion** e.g. *10 GBP in Bulgarian money*.
- **Measurement Conversion** e.g. *61 F in C*, or *16 stones in kg*.

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22-28.10.2007<*>DARTS<*>Dublin<*>Skybet World Grand Prix
22-28.10.2007<*>TENNIS<*>Basle<*>Swiss Indoors
22-28.10.2007<*>TENNIS<*>St Petersburg<*>St Petersburg Open
22-28.10.2007<*>TENNIS<*>Lyon<*>Grand Prix
22-28.10.2007<*>TENNIS<*>Linz<*>Generali Women's Open
25-28.10.2007<*>GOLF<*>Majorca<*>Mallorca Classic
26-27.10.2007<*>HORSE RACING<*>Doncaster<*>Trophy meeting
26-28.10.2007<*>DARTS<*>Bridlington<*>World Masters
27.10.2007<*>RUGBY LEAGUE<*>Huddersfield<*>First Test, GB v NZ
27.10.2007<*>HORSE RACING<*>Oceanport<*>Breeders' Cup
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Figure 2. List of Events for 27.10.2007

MM$_{PS}$ Processing

The purpose of MM$_{PS}$ processing is to match MM$_{PS}$ against the UP (for explanation UP shown on Figure 3 will be used) and modify MM$_{PS}$ in accordance with the corresponding DF$_{PS}$ to query (Q$_{PS}$). In the result of searching response (RPS) is produced and is sent to user i.e.

$$MM_{PS} \oplus DF_{PS} \mapsto \{Q_{PS}\} \mapsto \{R_{PS}\} \text{ and } MM_{PS} \varnothing DF_{PS} \mapsto Q_{PS} = MM_{PS} \mapsto R_{PS}$$

where symbol $\oplus$ means that MM$_{PS}$ match against DF$_{PS}$, and symbol $\varnothing$ has an opposite meaning.

{Q$_{PS}$} and **{R$_{PS}$}** designate finite sets of Queries and Response accordingly. **{Q$_{PS}$}** might be empty if, on the one hand, DF$_{PS}$ requires to take into account Events, but, on the other hand, at the current day required event does not exist. **{R$_{PS}$}** might be empty if in the result of both KB and Internet searching information was not found.
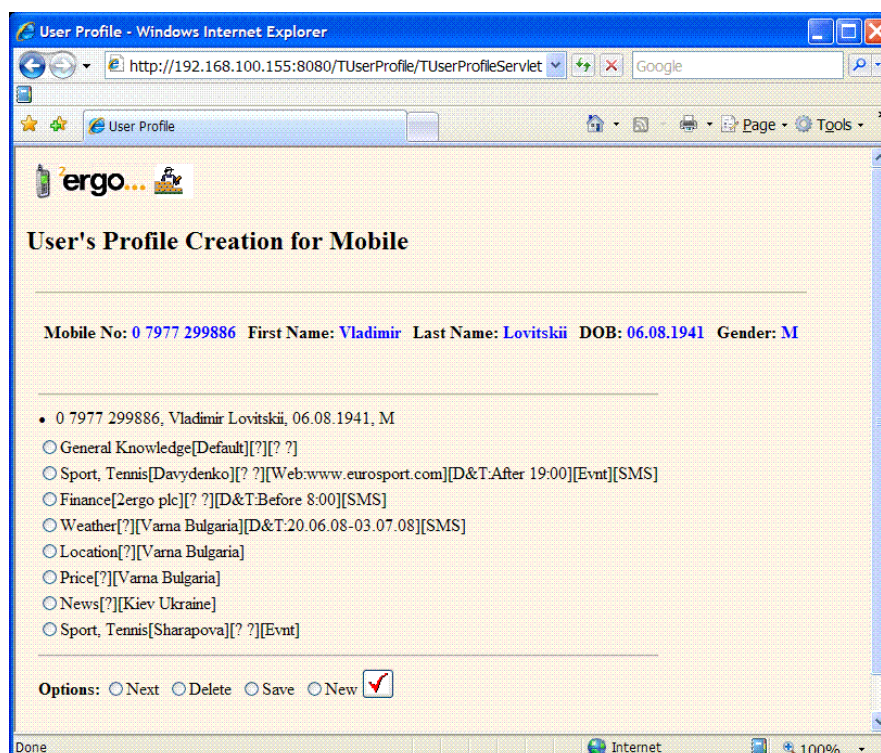

Figure 3. Example of User's Profile

A general process for MM$_{PS}$ modification can be explained by means of the following examples:

- MM$_{PS}$=*"a pizza hut"*. DF$_{PS}$="Location [?] [Varna Bulgaria]" (see Figure 3). In the result of MM$_{PS}$ parsing QAMEN placed *pizza hut* into value's slot **[?]** i.e. Q$_{PS}$=*"a pizza hut Varna Bulgaria"*.

- MM$_{PS}$=*"a HSBC Nice France"*. DF$_{PS}$="Location [?] [Varna Bulgaria]". In the result of MM$_{PS}$ parsing QAMEN recognised *Nice* as a city and *France* as a country, and replaced the contents of slot **[City Country]** i.e. Q$_{PS}$=*"a HSBC Nice France"*.

- MM$_{PS}$=*"p"*. DF$_{PS}$="Price [?] [Varna Bulgaria]". Value for slot is not given and that is why QAMEN generate the R$_{PS}$=*"What to you want to buy in Varna Bulgaria?"* and send it to user.

- MM$_{PS}$=*"s"*. DF$_{PS}$="Sport, Tennis [Sharapova] [? ?][Evnt]". If there is not any tennis events at the current day then Q$_{PS}$=**nil**. Suppose, MM$_{PS}$ has been sent at 27.10.2007 (see Figure 2). For this day four different tennis events occurred and therefore for queries have been generated by QAMEN: Q$_{PS}$={*"Sharapova Basle Swiss Indoors"*, *"Sharapova St Petersburg Open"*, *"Sharapova Lyon Grand Prix"*, *"Sharapova Linz Generali Women's Open"*}.

DF$_{SUP}$ Processing

The main purpose of DF$_{SUP}$ processing is to generate the set of Q$_{SUP}$ in accordance with Date and/or Time, and Events (if given), get responses and send them to users i.e.

$$DF_{PS} \mapsto \{Q_{PS}\} \mapsto \{R_{PS}\}$$

The subset of **{R$_{PS}$}** is shown on Figure 4.

MOBILE: 0 7764 446240
SMS = Weather for Wigan UK 11C Mostly Cloudy Wind NE at 10 km/h
　　Humidity: 82
　　Temperature:
　　Thu 10C - 3C
　　Fri 12C - 8C
　　Sat 16C - 13C
　　Sun 15C - 6C

MOBILE: 0 7764 446240
SMS = Broca PLC (BROC). 69.00p Down 1.00p (-1.43%). Market cap: £25.965m

MOBILE: 0 7977 299886
SMS = BASEL Switzerland - David Nalbandian lost to Stanislas Wawrinka in the first round of the Swiss Indoors on Wednesday three days after beating Roger ...

MOBILE: 0 7977 299886
SMS = PETERSBURG Russia - Top-seeded Nikolay Davydenko defeated Filippo Volandri 6-1
6-1 Wednesday to advance to the second round at the Petersburg Open ...

MOBILE: 0 7977 299886
SMS = Top-seeded Andy Roddick was upset by Fabrice Santoro in the first round of the Lyon Grand Prix on Wednesday at Lyon France. Santoro 34 hit three aces in...

MOBILE: 0 7977 299886
SMS = Linz Austria (Sports Network) - US Open semifinalist Anna Chakvetadze was an easy second-round winner Wednesday at the $600000 Generali Ladies Linz...

Figure 4. Result of Responses

Conclusion

In this paper we have proposed a profile-based approach to improve the efficiency of SMS. We turned our attention towards the UP creation and its possible application in a mobile environment. The object of our research is to improve query response by creating UP. Most importantly, the structure of UP and general process of personalization was given. It is important to offer and realize some ideas (not necessarily the best) when there are as yet no standards for representing UP, because there is no general agreement on what these profile should contain. Of course, the ultimate criterion of "good" UP is that a user should be satisfied with search results without the necessity of understanding the structure of UP, MM$_{PS}$ modification, search methods etc.

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