Beyond Recommenders and Expert Finders, processing the Expert Knowledge.

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Abstract

This is the era of Infopreneurs and web researchers for finding the best fit decisions. For general advice or recommendation, the information need arises. The advice should be such, that best fits the situational need, context and is feasible to afford. Research talks variedly about recommendation systems and expert finding systems for expert advice. These Expert Finding Systems and Recommendation architectures have many other angles which distort the real picture. Many issues like novelty, user friendliness, over-specialization, sparsity, scalability and information overhead due to time and resource, maturation effect of Context, Data and People's Knowledge fail to provide the best fit decisions. This makes the research for best fit recommendations or expert finding an infinite, inconsistent and highly circular in nature. This paper introduces a "knowledge prototype" which tries to solve most of the aforesaid issues, and is flexible and easily integrated into any other architecture. The Knowledge Grid or Knowledge prototype traps the dynamic contextual information and can serve any decision seeker at any time even without real time interactions. It harnesses its potential and performance and takes care of Environmental maturation effect.

Keywords: *Expert Finder, Expert locator, Expert recommendation, Knowledge sharing, Best fit decisions.*

1. Introduction

A lot has been written and analyzed about Recommendation Systems. From Google, eBay, Amazon to yahoo, Industry and Academia is working on Recommendation Systems to provide best fit expert list to end user's query. Somewhere Recommendation Systems is used as Middleware to E-Learning or E-Commerce Digital Library, somewhere it is assisting the search engines or shopping catalogues like Amazon, Netflix and many others. Many terminologies and frameworks are used to implement Recommendation systems such as ontology's, information retrieval etc. Recommendation Issues like "overspecialization", "novelty", "new user-new item" problems etc have been modeled from Multidimensional perspectives. The real scenario for best fit recommendations is beyond recommendation system's research. Recommendation System's research depends on factors, environment and context. This research is circular and is highly coupled with No of people, Domain, Architecture, real-time data and other recommendation issues. These are all ongoing process and its requirement changes with Maturation Effects from varying Architectures, Domain Models and changing environment of E-World. The real challenge in finding best fit recommendation is processing the synergy between the Recommendation Process and Expert Finding. Both Information and Knowledge are socially embedded in global and organizational climate.

Asking for recommendation from a known link or friend is more desirable. People rely more on recommendation of some expert than some ranked list finding system. But then again finding an expert is a tedious and complex job. The main contextual goal is the knowledge of the expert which is best fit for any recommendation problem. The provoking thought is that one cannot criticize a well renowned architecture or system. This work makes things simpler, viable and feasible by introducing a knowledge prototype which can function both for knowledge seeker and knowledge giver even without the presence of both. This Knowledge prototype can assist any recommendation or expert finding system as well. This paper first explores the Expert Finding System's landscape from Knowledge of Knowledge seeker and Knowledge giver's point of view in Section 2. The proposed Knowledge prototype is given in Section 3. The section 4 justifies the Knowledge Synthesis Model in Expert Recommendation Environment.

2. Knowledge Inferences and challenges of Expert finding systems.

Many researchers have seen Best-Fit decisions or Experts from multiple dimensional points of view. Earlier work [1-3] refer expert finder as expert locator systems or expert recommender, whose basic task is to find expert or group of experts for various cross disciplinary processes in an

organization. The processes are basically SWOT analysis of market trends. Expert finding is also used for Skill Management system required for futuristic growth of organizational knowledge. The key requirements of EFS can be named as 'The Expert Finding Life cycle model' as it seems similar to Software Development Life Cycle Model. This Virtual world sees [1] expert finding system as cost-effective, time consuming and good source of business opportunities. The EFLC (Expert Finding Life Cycle Model Figure 1 A) tells us about four stage process of expert recommendation [1-5], namely Identify, Classify, Validate and Recommend. Requirement Analysis of expert recommendation [1, 2] tells us about the Expert finding Life Cycle Model in detail.

1) Identify: Identifying an Expert is done from many resources such as self nominations, artifacts like email, messages, white papers and even project reports created by individual or created in project environment which implicitly calculates and maps the relevant experts in a given topic.

2) Classify: Classification is done on multiple evidences depicted by white papers and other documents. The main things in considerations are:
a) The type and level of expertise in Individual
b) The competencies and relationships among experts which further affects the communities of practice and research.

3) Validate: Firstly measuring the depth of expert Knowledge in the questionable candidate. Secondly this expertise qualification (rather call it expert quantification) can be done through Manual Assessment. Thirdly Marshalling evidences e.g. qualifications, resume, publications and user feedback, and also reputation of an expert in Industry.

4) Rank: Ranking or ordering the experts with perspective of their evaluation dimension like yrs and type of experience, certifications and publications.

5) Recommend: After final evaluation i.e. Comparing this ranked list on perspective of degree of knowledge of expert, the recommended list of experts or community of experts are returned to the interface.

The Challenges depicted by analysis of current scenario gives birth to feasibility, architectural and application constraints. This paves a new path of research to introduce the concept of Knowledge Synthesis in Expert Finding.

2.1 Feasibility Constraints as depicted by earlier systems.

The following gives focal points for feasibility Constraints in earlier expert finding systems:
a) The volume of white papers, are no indication of expertise as expertise profile changes with maturation effect and many of data on web is either not updated or suffers fake entries.
b) The first expertise you find may not be best one.
c) Some topics may require more practical human opinion than facts and figures.
d) Lack of access to resources. Absolute expertise information may be curbed either by expert or by their management.
e) New employees do not know about informal social links.
f) Privacy concern may limit the degree to expertise information sharing.
g) Expertise level in individuals varies and so does associations b/w experts.
h) There are no protocols specifying the criteria and/or qualifications necessary for particular levels of expertise.
i) Expertise change with time and requires to be noted for true evaluation.
j) Complex or out of the box problem can require group of same or cross domain experts.
k) Communication can be effected by geographical barrier, cultural and time differences. Also the communicational and knowledge level of expert and novice differs variedly.

2.2 Architectural and Application Constraints.

There are some research challenges stating the architectural and application constraints portrayed by some systems [1-3, 11-16]. These research challenges include contextual, environmental and other factorial issues as per application domain. These constraints can be affected by maturation effects, changing Knowledge levels of Knowledge giver and seeker. Also emotional and physical stress levels can produce variations in the performance of expert finder results. Most importantly the availability of expert at the time of Information need. Many research analogies talk about this best fit expertise recommendations from different angles. Some talk about availability of expert, some state difficulty in data profiling, some talk about Data model problems like scalability, novelty, sparsity, overspecialization in the best fit results. And some point at problems of new entries into the scenario that may prove to be good expert but are not focused much in results. And some new users using the system do not know what they should search for even. One has to look at this best-fit expert finding research

from a central angle which balances the whole approach at least to some extent.
1) Expert Disclosure: One must know that what motivates the expert to provide their information in Knowledge Nets. This would update the expert profile model from time to time. This is called as self referral or self reporting [6] also.

2) Time Factor: The time duration in which expert is able to solve the pertinent problem is one of the key factors of expert search.

3) Knowledge Searching: One must see that the expert finder matches to the requirements of Knowledge Discovery Events. The keywords by end users should be analyzed thoroughly for their information need and context thereby satisfying the knowledge needs of the users.

4) Knowledge Stewardship: Knowledge sharing culture in an organization is a big need for expert finding. Knowledge of past and present needs to stored and updated from time to time. Knowledge shared also contributes to best fit expert list in first phase processing.

5) Practical Problems of expert finders: In some work [2, 3] the author focuses on practical problems of current expert finder systems i.e.
a) Updated Information of Expert-Profile as expert profiles are often missing, out of date or incomplete. (pre and post verification and validation of expert profiles).
b) Real-Time and Instant help for searchers psychologically matter expert search and is one of the implicit requirements.

6) Enterprise Awareness [8]: The Knowledge level of the staff needs to be measured from time to time through corporate transactions, workshops, events or performance appraisal.

2.3 The Triangulated approach towards expert search.

The triangulated Approach for prototype Expert Finder system is basically an automated Expert Profile Creation and Maintenance module which further consists of:

1) Verification and Validation done at two points: (Self Reporting and Feedback) i.e.
a) Validated by another expert.
b) Feedback on Expert n current system by the end user or searcher.

2) The prototype [2] triangulated approach based expert finder system is made after some ground work as per follows:
a) Comparative study of literature comparison of current expert finder systems.
b) Requirement and Feasibility study of two models of knowledge Intensive Organization. And same had been used for usability study.
Maintaining and updating expert profiles can be done by Self referral systems [2,6], using inputs from email, webpage, bulletin board, software code, technical reports, artifacts of social software systems and social networks. They all suffer from problems of cross validations (pre and post verification and validation of expert profiles) of authenticity of data. Also it needed to measure not what people know but who knows what equation.

3) Social Network and path of expert search: Restricted Social Network due to company policies and privacy concerns again narrows down expert search to local intranets. The navigational path of known network or social circle influences searching of an expert and impacts time and resources. Many social circle sites like face book etc give opportunity to multiply your network through friends of friend's clause. This broadens your horizon to look for particular knowledge expert or collaborative environment to solve a knowledge problem.

3. The proposed Knowledge Prototype for expert knowledge synthesis.

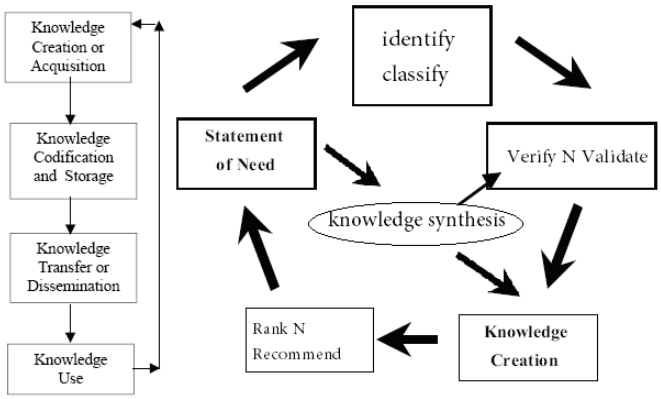

Fig.1 An Expert-Knowledge Life Cycle Model (Proposed Model) altered version [7, 10].

In this research a novel framework is proposed that is, the Knowledge Synthesis Model (Figure 1) for any Expert Search. The main parts of this framework have been taken from Knowledge Management Process [7, 10] which has been mapped to Expert Finding System's Context to develop Knowledge Synthesis Model. The pivotal point to be noted is that all these phases of Knowledge Synthesis must be interconnected with effective feedback system.

The paradigms of new Knowledge Synthesis model are discussed below:

1) Converting Data to Knowledge: Keywords from search, Heterogeneous and homogeneous sources of expert Information. Expert, Data and Environment together contributing towards a larger picture called Knowledge Profiling.

2) Connection People to Knowledge: Augmenting Expert Profiling by validating true information source of experts. The idea here is to connect expert and the knowledge seeker in their knowledge context rather than environmental issues.

3) Connection People to People: Learning from Referral Web [9]. Here the learning methodology is extracting expert information through the parsing of social connections and navigational links. Close neighbourhood entities or small graphs or shortest path can be evaluated from infinite and multiplying social networks.

4) Connecting Knowledge to Knowledge: Knowledge Creation (The Proposed Model).

The Following points (3.1 to 3.3) are Knowledge Synthesis of present Expert Finding systems [1- 6] and their Knowledge Need:

3.1 The Need of Knowledge synthesis in the context of expert finding

The entire Knowledge Synthesis drives the search for an expert in any application domain with varied requirement structure [1-5].Some of the points to focus:
a) Background of User plays important role in Knowledge requirement engineering
b) One needs to know whether the user wants a quick answer or just a technical discussion.
c) One needs to know whether the user's question is answered by how-to-do tutorial or jus some web references.
d) One needs to know whether the user's question is answered by single domain expert or cross disciplinary approach.

The other dimensions of this Knowledge synthesis:
1) Identification should be done three dimensional way that is Expert, the searcher and context.

2) Classification of an Expert must be done after Knowledge Synthesis of the Context.

3) Validation should also involve the reliability factors like Edit ability and scrutability. That is as and when required the changing context can also vary the expert search giving user a wide and flexible choice. This also takes care of over specialization and novelty issues in best fit search.

4) Ranking is a big word when it comes to quantifying an expert to relevant user. The ranking should be rather mapping to best fit search by weighing not only expert attributes but also involving environmental variables and Feedback from past.

5) Abstract nature of Recommendation Process recommendation is a very critical word which should not only provide best-fit decisions but also remodel the system to save from maturation effect.

6) There is no real-time variable which takes care of instant or current data and maturation effect. As needs, life-styles, technology changes with time in the whole approach.

3.2 Recognizing the Knowledge Need from the angles of knowledge giver and knowledge seeker

The knowledge need of both expert and searcher should be first profiles and recognized. This should be followed by effective mapping of expert Knowledge with requirement analysis of search. This knowledge degree say alpha should also contain the factors of reliability and support for real time transaction and availability.
Expert Finding is an ambiguous and difficult task as expert knowledge and profiles are not updated from time to time on World Wide Web. Expert Information is difficult to ascertain, the trends and maturation effect of knowledge also effects expert profile and search needs. It is difficult to ascertain the varying degree of expert Knowledge. Expert finding is much more than analysis of requirements and challenges, surveying current state of the art in, and commercially available tools. Following points justify the viewpoint:

1) With increase in fake data entries for increase brand recognition and other types of mal practices, getting a true evaluation of expert profile and his white papers is difficult.

2) User-Friendliness: Even best of expert may not be able to solve your problem or maybe a novice expert solves your problem by giving you instant real time solution. These points to physiological barrier or people's problem

angle in this research. In software quality analysis this is known as User Interaction or User Friendliness.

3) Privacy concerns, new user new expert problem and over specialization in search focuses on the need to build an independent knowledge prototype which records relevant expertise knowledge to give real time solutions.

4) Maturation effect hits large on Context, people and data angles thereby failing prevalent architectures and making the research circular coming back to the same point.

3.3 The mismatch picture of Knowledge Profiling.

The following justification supports the miss match knowledge profiling done in present Expert Finding systems:

1) Updated Information of Expert-Profile as expert profiles are often missing, out of date or incomplete. (pre and post verification and validation of expert profiles).

2) Support for Real-Time transaction and Instant help for searchers is missing. Most of the users either get bored or confused to fill the right data. They do not get help at right time from right kind of people.

3) Recognizing people's need: whether they want expert-list or expert to solve problem instantly. Example Question-Answer sessions caters to information need than expertise need. The background study of searcher is also imperative to trace his search need quotient. Both Searcher's requirements and activity needs to be measured in order to infer required expertise level or expertise need. There is difference between Information need and Expertise need.

4) The search or recommendation of expert needs measure i.e. how accurate was the expert search, how it benefited the end user, to what degree? This shows that expertise recommendation needs multilingual feedback prototype.

5) Increase in Social Space: The research area on social links can add to human touch in human-computer interaction. Here when an expert profile adds a contact node he gains not only that contact but also all the network of contacts added to that contact.

6) The research on Self Reporting [6] Process needs further study and improvement than the process followed by face book or Linked In because not every applications domain has same requirement and contextual architecture as that of these social networking sites.

7) Some work [1- 5] tells us about research problems like how to contact the expert (newspaper, email, mobile, radio interviews).This points to a problem of experts or expert knowledge is geographically dispersed in this giant information space of E-World.

8) Effective Feedback Recordings of sessions between Expert and Knowledge Seeker: The updated Feedback system of past Expert Interaction sessions are pivotal in revamping the Knowledge Base, taking care of expert need even if expert is not available and also gives a good feedback to ranking algorithms.

9) Communication Media or Implicit requirements [4-6]: The media of communication b/w expert and searcher should be dynamic enough at both ends. Important dates of expert availability and duration of time in which expert is needed by searcher should be available. This cut down the Traffic b/w expert and searcher and list is prioritize according to searcher's need, helps to ranking best expert and get his availability.

10) Issues unfolded in the Algorithm [1-3]: Expert Search Algorithms mostly go for Keyword matching but not more appropriate context matching. Keywords can cost more overhead. Secondly assigning weights to words in combination of keywords is necessary according to synchronization of search sequence.
Thirdly while calculating the ranking, the parameters need to be checked for authentic and feasible data and parameterized according to priority.

11) Knowledge Inference regarding certain parameters [2, 3]: The work shows good assessment of expert finding and educates on how to calculate Expertise Ranking and important keywords like Expert's Availability Score A, (Query, Keywords) Searcher Available, Helpfulness and Recommendation. The ranking is at last calculated as software quality calculation. The need is to test the usability test for any ranking algorithm, which the author has conducted. This work elaborates about level of agreement matrix for system ranking and user ranking.

12) Computation of Social Links: Utilities to facilitate this searcher-expert transaction model should be provided at both ends. Link to searcher's social link (useful to alternately contact the expert) can be used. Social Link with computed paths (shortest path) first can be given at times when concerned expert is not available. Other important considerations are the Keywords, Knowledge from previous expert interactions, Context matching of such previous solutions to searchers query, Expert List from previous solutions which can be present in their present social network.

13) Emotional Issue of an Expert: The mindset or motivational level of expert also matters in showcasing his true skill set to the world. New system new environment, Overspecialization, or new expert getting low feedbacks or ratings may de motivate an expert from sharing his knowledge. Also privacy concerns of getting into expert's information, navigational links and white papers may be inappropriate to the expert or his working environment. And thus the result set may lack all details of expert and his contextual information on searcher's request. Subtle measures can be taken on account of Expert Profiling like feedbacks of interactions or ratings mailed privately, ratings given in number or grades rather than text, analyzing the actual reasons of client dissatisfaction and improving upon the expert-client interaction in more strategically and amicable ways.

Apart from all these critical points, firstly there is a need to make accurate and correct requirement model of the query. This requirement model can be taken as nodal point from which the deviations of knowledge required and knowledge known should be measured. Also these deviations are effected by knowledge-fitness level of the user who is asking the query. At times the user themselves do not know what they want, and are unable to either quote the query correct or get exhausted to give detail information required to build the profile model. User Interface and communication also plays vital role in this.

4. The role of Knowledge Synthesis in expert finding systems.

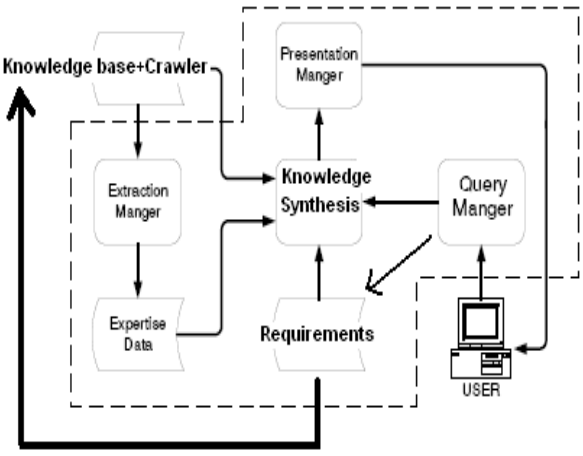

Fig. 2 The Knowledge Synthesis Model in Expert Search, altered version of Expert Finder System [4].

The importance of inculcating knowledge environment: Formulating the need of search into a knowledge model as depicted by Figure 2. Expert Disclosure is not more important that inculcating a Knowledge Environment which fosters Knowledge sharing, Knowledge Stewardship [1] and increases the Knowledge degree which calculates the maturation of context, people and data. This Knowledge Net should take care of privacy and other concerns which hinder people to share their knowledge due to privacy, overspecialization, cold start and fake entries issues.

1) The Expertise Recognition Logic and evidence [4]: Capturing organizational Knowledge for expert finding also points to the process of knowledge synthesis due to following short comings:
a) Processing heterogeneous and homogeneous sources of Knowledge is difficult.
b) Expert Finding Systems usually do not spend much time on researching Knowledge sharing and knowledge capturing activities before recommending the best fit list.
c) Some work [4] also focuses on "analysis functionality" i.e. Expert finding need comprises of either search for an expert, or information centre or collaborative environment best fit to requirement engineering.

2) Problems like Interoperability, Validity and consistency of data [4]: The data needs to be validated for "dirty data" or false entries, acceptable common format to be processed and a prototype which is acceptable in any environment.

3) Expertise Selection with Implicit and Explicit Preference and Privacy Control [5]: The need-gauge meter defines the boundary of implicit and explicit requirements of the expert seeker or information seeker. The location, time, ranking of expert, age and other factors play role in expert search. Bidding preference for certain type of expert on feature sets (static or dynamic) are the explicit requirements of expert search. These preconditions are more like oracle SQL Conditions.

Example: I prefer candidate A to B if he has highest marks in web course and is also a good tennis player. These pre and post conditional requirements make the Preference Model. Implicit preferences are more of default preference, say meeting time, location, mode of communication etc.

4) Awareness of Experts in our personal environment [8]: There should be "Awareness of Experts in our personal environment" [8]. Awareness is a big word to define in contextual expert search. Awareness about the expert and knowledge need should be measured and recorded.
Three renowned systems [8]: MITRE's Collaborative Virtual Workspace (CVW), Expert Finder and XpertNet worked on automating intelligent entities to cite and quote

the awareness of expert in and around any organization. Awareness can be both dynamic and Static. Awareness Model comprises of People, Information, Tool and Activity. This is very much depicted in the proposed model in Figure 1.
This gives a very good idea of a "Knowledge Prototype" which may solve most of the issues of Expert Finding Systems.
The Expert Finding Logic is the nodal point of all recommendation and information retrieval systems. The basic goal is to find the right expert with enough contextual knowledge that matches the end user. Also availability of expert and on time is crucial for expert-end user interactions. This Knowledge prototype takes care of such situations where the expert, even if unavailable, the solution can be provided from Knowledgebase obtained after 2-3 training sessions of Knowledge prototype., the number should be given on the last line. Also the real time data is generated by crawler at backend of knowledge base which follows a filtered pattern.

5) Unethical and Inconsistent Issues of Self reporting, Usability Study and other Rating Systems [6]: Rating systems are highly biased on like-dislike factor, over and under specialization due to brand marketing and Denial to feedback system. Self reporting can also lead to privacy issues, unauthentic data and thus bring inconsistency in expert search process. Usability Study also affects many of the architectural concerns as it can also impact scalability and scarcity issues along with others.

6) The power of Referral Web [9, 16] and their Link analysis: The referral web and Link analysis play pivotal role in Expert Finding. Referral webs provide organization charts, forward and back linking in research and scientific communities, navigational paths of browsing etc. The referral web expands the expert search horizon from small personal network to larger community uncovering the hidden expert connections and their information. Referral web further augments Profiling: say the preference profile, expert and their related data profiles changes not only with time, changing needs but also connections and this need to be recorded for better expert locations.

4. Conclusions

This paper tries to cover all the focal points of expert search, rather go beyond expert modeling, recommendation systems and try to grab the contextual Knowledge which is driving force for any Information system, search engine, recommendation process or locating any expert. This work recreates a need for Knowledge synthesis environment or a highly inter-operable prototype which is issueless for architectural and requirement barriers of any application domain.
Now for expert X, the information extracted is like: information about which units one teaches, expertise areas, grants, etc. can be gained from internal DB and personal websites.

A big issue is how to reconcile b/w the difference in output coming from these heterogeneous sources. How fast expert-profiles are updated is the matter which requires calculation. The most up to date expert result should be oriented or ranked date wise, expertise level, matching context of search topic, and balancing difference of output from heterogeneous data, availability of expert to that particular instant when searcher needs him.

Both Searcher's requirements and activity needs to be measured in order to infer required expertise level or expertise need. There is difference between Information need and Expertise need. There is requirement of Utilities to facilitate this searcher-expert transaction model which should be provided at both ends. This should be done in sequential order.

Search Keyword, Knowledge from previous solution, Context matching of such previous solutions to searchers query, Expert List from previous solutions which can be present in their present social network.
Other important issues like Link to searcher's social link and shortest path also contribute to knowledge synthesis. Social Link Analysis is useful to alternately contact the expert. For this analysis, there can be alternate path to look at social Links with computed paths (shortest path first).
Self reporting needs to be organized on more user friendly interface.

Issues like Fake entries, privacy concerns, new user-new item problems, maturation effects, overspecialization and scarcity all can make any expert finder or recommendation systems fail with even best of consistent environments. A small look at Context and Knowledge can save a lot and it would be easy to give best fit decisions with less of resources.

Recommendation Systems and Expert Locators lead to circular research problems due to change in Environment, Context and scalability of Datasets. Thereby need arises to introduce a knowledge prototype which reasons the very being of search entity in this World Wide Web. This knowledge Net catches the context of user, data and their environment and tried to recommend the best fit or the most viable expert. In next paper, this work would be extended by introducing the Grid Matrix with Knowledge Concern Variables to evaluate decision making systems.

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