# Owls of SPA: Studying stack-overflow experts evolution in single page applications web-frameworks.

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Single page applications (SPA) frameworks are becoming an important technology stack over the Web, as the adoption of SPA depends on the number of knowledge resources; experts in this domain become an important group because they generate knowledge that is useful for practitioners. This research analyzes the evolution of experts in the SPA cluster of StackOverflow, using the mean expert contribution (M.E.C) as a metric of expertise in combination with the yearly retention rate. Results show that only that only 20% to 30% of participants are experts and an average of 26% remain active, with 96% specializing in only one framework over time. This study suggests that knowledge distribution follows a Pareto distribution for this cluster, experts remain active in the same proportion over time, and they stay with a technology stack, preferring to be specialists than generalists and don't switch to another frameworks.

Additional Key Words and Phrases: StackOverflow, Experts, Retention rate, Angular, Ember, VUE, React, Single page Applications, SPA

## 1 INTRODUCTION

As web framework technology scales and invade Enterprise domains, analyzing the behavior of the web community of practice is becoming a software engineering new requirement. In 2014, Storey et al. [2014] gave insights into how social media is changing the software engineering process and stated that:

> "Software developers rely on media to communicate, learn, collaborate, and coordinate with others."

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The complexity involved developing single page applications (SPA) using web frameworks in a fast evolution environment as the world wide web, leads to a constant decision-making process about which framework to start, stop, continue or switch. Classical technical concerns in software engineering are well analyzed and understood with established best practices in Software Architecture, however web applications frameworks are constantly affected by the "community of practice" which generates crowd-sourced knowledge in an empirical, highly disorganized manner, relying mainly on a mixture of forum posts [1], repository metrics [2], and Q&A forums [3], were experts gain an important role over the complete life-cycle of a technology as catalyzers of knowledge and confidence for new adopters. For a better understanding of the community of web practitioners, this research will investigate the evolution of SPA frameworks experts in stack-overflow Q&A focusing on Angular, ReactJs, EmberJs and VUE, comparing experts activity over time. Web experts construct a dynamic body of knowledge over time with short lifespan due to technological changes. Experts behavior evolution could give insights about how safe is to use technology, what makes it reliable and how to create work frameworks that potentially attract and make comfortable this group. Research done by Pal et al. [2012] studied the evolution of experts in stack-overflow considering changes over time. The approach taken in this research paper will measure the evolution of SPA experts in StackOverflow Q&A focusing on the retention of experts over time, appliying the Mean Expertise Contribution (M.E.C) [Yang et al. 2014] because it's deal with the gamification effect existent in this Q&A forum.

This research seeks to answer the following research questions:

**RQ1.** How experts evolve over SPA space in StackOverflow?

**RQ2.** How does the retention rate of experts evolved over the time regarding web frameworks?

**RQ3.** Do web experts, stay, change from one framework to another or specialize in many over time?

The contributions at product level about how experts evolve in this domain could help in the selection of potential technologies for long term Enterprise applications. Defining social specifications when engineering software, estimate better learning and preparation time for development teams and study what makes a web framework attractive for experts.

## 2 DATASET DESCRIPTION

StackOverflow is a questions and answers (Q/A) website dedicated to computer programming. As any Q/A site a user adds a question and wait for someone else to answer it. People who answer correctly earn reputation through gamification that includes points and badges. It started in 2007 and currently has 17 million questions, 26 million answers, 9.8 million users and 10 million visits per day [4] is one of the most relevant Q/A site for developers. Due to the number of programming languages and technology stacks is possible to define a space as a container of technologies that are related to a higher concept. For this research the space of study contains frameworks for client-side single page applications (SPA) and focuses on Angular, Ember, React, and VUE. Angular is powered by Google and its online community, it started in 2016 as a complete rewrite of AngularJS. Angular targets mobile, web and desktop, and use the web component concept (do not confuse with native web-components). EmberJS [5] is a Model View ViewModel Controller (MVVC) web framework created by Yehuda Katz and the Ember Team [6]. React is maintained by Facebook and its online community appeared for the first time in 2011 and was open-sourced in March 2015. React only deals with the View Layer of an MVC architecture, it makes use of unidirectional data flows in a design

[1] www.medium.com
[2] https://github.com/
[3] https://stackoverflow.com/
[4] https://stackexchange.com/sites?view=listusers
[5] https://guides.emberjs.com/release/
[6] https://emberjs.com/team/

style called Flux architecture. VUE is a SPA framework created by Evan You [7], it is based on AngularJS and thought as a lightweight framework to do. VUE core is focused on the on the view layer. Although they are developed with different technical philosophies, this research studies them as a whole focusing on StackOverflow participants[8]. Questions and answers (Q&A) were obtained by Tags filtering considering the main tags (Angular, Emberjs, react.js, and vue.js), on table 1 is shown the number of Q&A per framework and figure 1 the trending over time.

In the next section, the evolution of experts will be studied using the Mean Expertise Contribution (M.E.C).

## 3 EXPERTS EVOLUTION IN SPA

The number of initial participants, users of stack-overflow in the domain of SPA than answers questions, in every framework of the study is shown on figure 1. The retention rate is defined as the ratio of active existing participants in $P_{existing}(n)$ and the number of active participants in $P(n-1)$ (including both new and existing) where n is the year.

$$Ret(n) = \frac{PE_{existing}(n)}{P_{total}(n-1)} \tag{1}$$

Measuring the retention rate using equation 1 the participants average is for Angular 29%, Ember 26%, React 33.6%, and VUE 20%. Despite the different tendencies and the number of participants shown on figure 1(e)(f)(g)(h) retention rates of participants remain stable over time around approximately 20% and 30%.

Experts will be defined as a user with an M.E.C greater than 1. The mean expert contribution [Yang et al. 2014] takes into consideration answering quality, question debatableness, and user activeness and is defined as:

$$MEC_{u,t} = \frac{1}{\mathbf{Q}_t^u} \sum_{\forall q_i \in Q_{u,t}} \mathbf{AU}(u, q_i) * \frac{\mathbf{D}(q_i)}{\mathbf{D}_t^{avg}} \tag{2}$$

where:

(1) $\mathbf{AU}(u, q_i)$ is the utility of the answer provided by user u. For this study is defined as the inverse rank $\mathbf{AU} = \frac{1}{Rank(q_i)}$
(2) $\mathbf{D}$ is the debatableness of the question $q_i$ calculated as the number of answers $A_{q_i,t}$ provided for question $q_i$
(3) $D_t^{avg}$ is the average debatableness of all questions realated to the topic t, calculated as $\frac{1}{Q_t} * \sum_{\forall q_j \in Q_t} \mathbf{A}_{q_j,t}$

The total number of experts accumulated over time for Angular was 11,083, Ember 1,871, React 9,933, and VUE 3,363 a total of 26,250. Figure 1 shows that the number of participants with its retention rate of experts were values around 20% to 30% (Angular 31%, Ember 27%, React 34%, and VUE 24%) and follow over time the same tendency as normal participants.

An expert that is fluent in more than one language will be called polyglot and those who only use one specialists, to find how much experts belong to this group, sets of 2, 3 and 4 elements containing the all possible intersections for this space were evaluated as shown table 2. From 26,250 experts only 1,143 (approximate 4%) of the total count of experts are polyglots and 96% are specialists.

| Framework | Questions | Answers | Average debatebless |
|---|---|---|---|
| Angular | 140,416 | 173,393 | 1.53 |
| Ember | 5789 | 6246 | 1.35 |
| React | 103,484 | 128,652 | 1.53 |
| VUE | 25,841 | 30,274 | 1.40 |

Table 1. Average debatebless on SPA frameworks in Stack-overflow until December 2018.

| Intersection | #Experts |
|---|---|
| A-E | 45 |
| A-V | 190 |
| A-R | 487 |
| E-V | 28 |
| E-R | 67 |
| V-R | 244 |
| A-E-V | 8 |
| A-E-R | 12 |
| A-V-R | 48 |
| A-V-R | 10 |
| A-E-V-R | 4 |
| Total | 1143 |

Table 2. Experts with knowledge in different framework combinations win the SPA space where; A:Angular, E:Ember, R:React, V:VUE

## 4 CONCLUSIONS FUTURE WORK

The number of QA only increase or decrease the number of experts but the retention of them remains constant over time between 20% and 30%, with an approximate mean of 26%. Expert activity retention is not related with a high number of questions, where over time 20% to 30% of the participants are experts approximates a Pareto distribution in stack-overflow for the SPA framework cluster.

Only 4% of the experts are polyglots (knowledge of more than 1 framework) meaning that 96% of experts prefer to specialize in one framework over time and don't switch to another frameworks over time. New metrics to correlate the social and technological aspects of web software considering the relation of software quality and number of questions could be proposed to understand better why different SPA have different numbers of Q%A.

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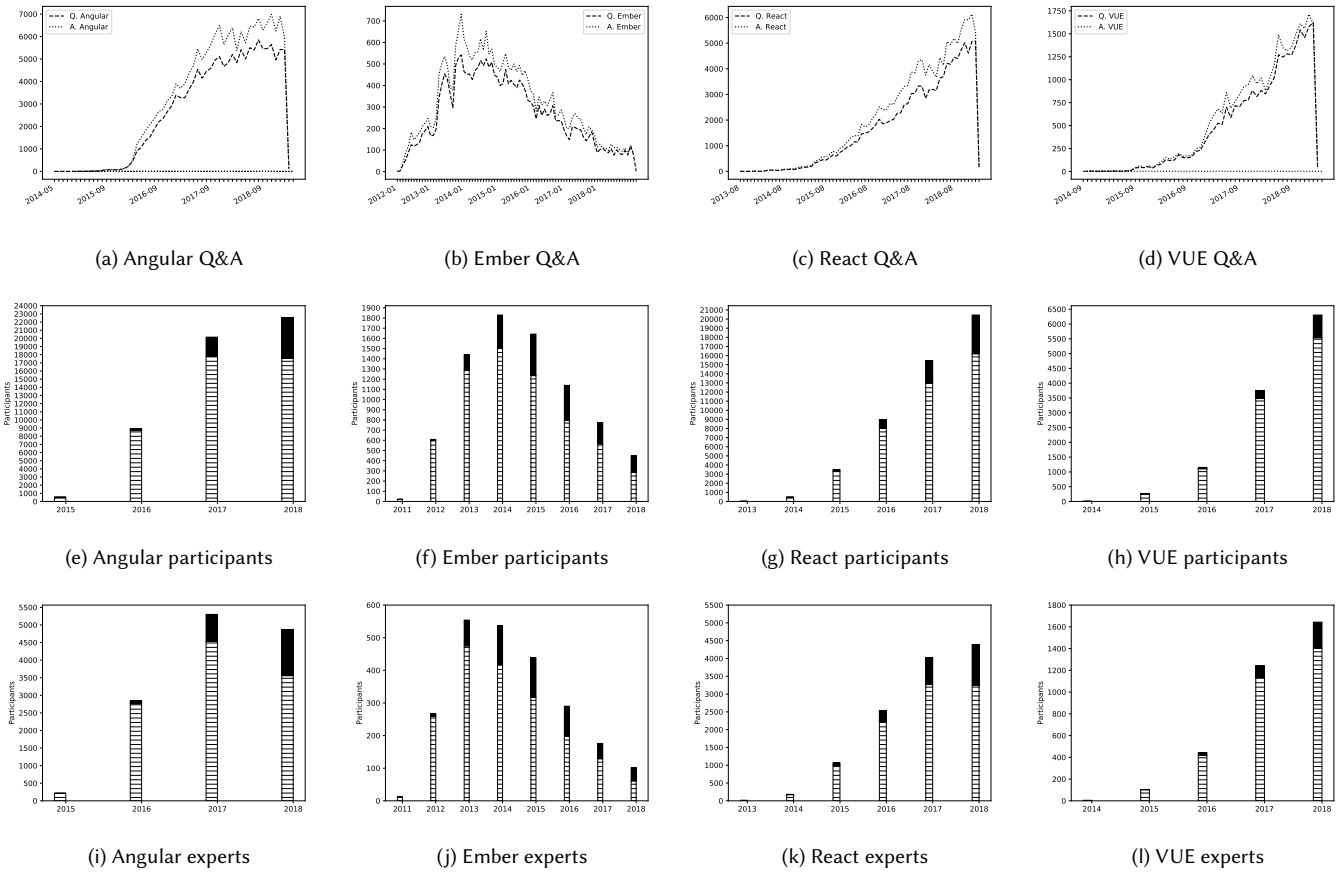
[7] https://vuejs.org/v2/guide/

[8] Extracted from https://archive.org/download/stackexchange on December 2018




(a) Angular Q&A (b) Ember Q&A (c) React Q&A (d) VUE Q&A

(e) Angular participants (f) Ember participants (g) React participants (h) VUE participants

(i) Angular experts (j) Ember experts (k) React experts (l) VUE experts

Fig. 1. Stackoverflow QA participants for each framework in the SPA space, where the dashed hatch indicates new and the solid one retained.