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## Designing sweet biscuits packaging by considering the level of attractiveness based on eye tracking data

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# Designing sweet biscuits packaging by considering the level of attractiveness based on eye tracking data

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**Abstract.** The diversity of types of packaging of the product is not entirely desirable by consumers. This study aims to conduct a ranking analysis on packaging, an analysis of the correlation between fixation to the level of attractiveness, and packaging design that is of interest to consumers. Data collection was obtained through eye tracking and post exposure questionnaire for 49 respondents. The analysis shown that the correlation between fixation to level of attractiveness is not correlated, due to external factors such as brand image, brand familiarity, and others. Then, the design of the product packaging is done where the basic orange color packaging concept and its packaging elements are obtained based analogous theory. A concept testing was done afterwards and revealed that the overall packaging design can meet the needs of consumers with a percentage of fulfillment above 70%.

## 1. Introduction

Product packaging is one important element that needs to be present in a product, because one of the functions of product packaging aims to attract consumer buying interest. In addition, one factor of product quality is the product packaging itself. Apart from the packaging aspect, the elements on the packaging also need to be considered in order to avoid mistakes in delivering information to consumers. Therefore, this research conducted analysis of ranking based on eye fixation on biscuit products packagings, analysis of the correlation between fixation and attractiveness, and designing packaging design concepts that are of interest to consumers. Through this research, it is expected to be a benefit for companies to make attractive packaging design recommendations so as to increase company sales, find out the correlation between fixation and attractiveness, and determine the placement of packaging elements that are of interest to consumers.

Visual attention from human vision is divided into several stages, namely the stage of giving a stimulus, the position of the eye fovea looking for a stimulus that attracts attention, and the eye fovea focus on a stimulus because it is considered attractive [1]. The model of eye movement is divided into 2, namely saccades which are reflex eye movements and fixation of eye movements that are centered and stable [1]. Then, eye tracking is an eye tracking method used to study visual attention in the human eye. Eye tracking can determine 3 important points, namely in which part of the eye's eye view, how long the eye sees at a point, and the cycle of eye sight movement from one point to another.

Eye tracking methods have been widely used to analyze user experience. User experience measurements performed using an eye tracker will produce eye movement data that can be tracked and recorded. This is closely related to the cognitive processing activities of users over time [2]. This method is used to get consumers' visual attention which is measured and analyzed based on gaze plot and heat map analysis [3]. Santos et al. (2018) measured areas of interest (AOI), namely areas on posters and videos that had been marked to obtain more detailed information. AOI is marked in the form of a product brand from a company and the type of product advertised so that for each AOI obtained time fixation (time viewed), time of first fixation (time to first view) and number of fixation (fixation) [4].

According to Estiri et. al. [5] product packaging is a layout that contains visual attributes of information that consumers want to receive. Some functions of product packaging are as follows namely



as a media that protects the product from external influences, as a product identity, and serves to improve product efficiency. In addition, the elements contained in product packaging include company names, brands, raw materials, net weight, nutritional value information, barcodes, and product images [6]. Often, product packaging is the initial interaction between the product and its users. There are six factors forming packaging visual appeal, namely the layout factor, brand factor, illustration factor, typographic factor, characteristic factor, and color factor. Therefore, product packaging must be designed by considering the visual appeal of consumers because the packaging will directly deal with consumers so that consumers will have their own image of the product that reflects the desired brand image of the company. Product packaging also influences purchasing decisions which are classified into labels (some clear information), shapes, materials, colors and images. Overall influence consumer purchasing decisions by 53.40% [7]

In this study, there are 3 important variables that considered as dependent variables, namely recall, likeability, and suitability. Recall is "to remember something", which has the meaning to remember a thing that has been seen or felt. Then for likeability comes from the word likeable, which is "easy to like", which means to like something easily. Then for suitability that is "the degree to which someone or something is suitable for a particular job or purpose" which means an assessment of the level of suitability of a thing. These terms was used in the research done by Husić-Mehmedović et.al [8] where recall variable is used to measure something that is remembered, then for the likeability variable is used to measure the level of interest in a thing, and for the suitability variable is used to measure the level of suitability of a thing.

The statistical test used in this study consisted of several methods, namely the Pearson Product Moment validity test, the Alfa Cronbach reliability test, and the Bivariate Pearson correlation test. Pearson Product Moment validity testing according to Sugiyono [9] is considered valid when the data can be used to measure what you want to know or measure. Bivariate Pearson correlation test is hypothesis testing which aims to find out the relationship / relationship between the independent variable with the dependent variable [9].

After statistical testing, the product design and development process are carried out. According to Ulrich [11], product design and development is an activity that aims to add or renew the use value of an existing product or a completely new product. The steps undertaken to carry out the process of product design and development include the following, namely identifying consumer needs, establishing new product specifications, composing new product concepts, selecting product concepts, testing the concept of product selection results, and making new product prototypes.

## 2. Research Methodology

The research process is carried out in a laboratory that is soundproof and free of all content that interferes with the running of the instrument. Respondents sit in front of a 32-inch Full HD LED monitor and eye tracker position which is located below the monitor screen. The eye tracker device used is Gazepoint (<https://www.gazept.com/>) with a GP3 model that captures eye sight at 60Hz frequency. In this eye tracking process, 2 types of eye movement models can be obtained, namely fixation & saccades [1]

In this study, the results of eye tracking in the form of many fixations are independent variables, while the dependent variables come from the results of the post exposure questionnaire. The process of this research was conducted on 49 students of the University of Surabaya from various faculties as a sample target. Then for the research instrument divided into 4 stages, namely the calibration of the eye tracker tool to the pupil area of each respondent's eyes, the appearance of images of 20 types of biscuit products displayed in a row, the individual performances of the 20 types of biscuit products available and the size of the enlarged image (zoom in), and questionnaire after the data collection process with an eye tracker to measure 3 variables, namely recall, likeability, and suitability.

After the eye tracking instrument process is completed, the data is analyzed statistically related to the results of eye tracking and the questionnaire. The first is to test the validity of the recall, likeability, and suitability questionnaire variables. The second is testing the reliability of the questionnaire variables recall, likeability, and suitability. Third, testing the correlation between variables from eye tracking to

the questionnaire variables. Then the results of correlation analysis of eye tracking data with a post exposure questionnaire are associated with the process of product design and development to produce a new product packaging design based on the level of attractiveness of consumers.

### 3. Results and discussions

Data processing was carried out on the results of eye tracking instruments, namely the results of the questionnaire along with the data on the results of eye tracking. Based on the results of the instrument, the following demographic data of research respondents:

**Table 1.** Demographic data of respondents.

Sample Structure		N	%
Gender	Male	33	67
	Female	16	33
Age	<18 years old	1	2
	18 years old	1	2
	19 years old	12	24
	20 years old	14	29
	21 years old	15	31
	>21 years old	6	12

Based on the results of statistical tests regarding the validity testing on recall, likeability, and suitability questionnaire variables indicate that all variables are valid, because the Pearson Correlation value of each brand of biscuits above the  $r$  table value of 0.2377 ( $\alpha = 0.1$ ;  $N = 49$ ). Then, for reliability testing shows that the variable recall (0.951), likeability (0.805), and suitability (0.860) have Cronbach's Alpha coefficient above the standard, which is 0.70, so that the three variables are classified as reliable. After testing the validity and reliability of product ranking analysis, the ranking is based on the longest fixation time, because the results of eye tracking variables are more quantitative in nature when compared to the questionnaire results variables. The following table is the result of eye tracking and also a questionnaire sorted by the longest fixation time:

**Table 2.** Ranking sequence based on average percentage of fixation.

	Average Fixation [%]	Recall [%]	Likeability [%]	Suitability [%]
Gery Malkist Salut Coklat	7,56	68,57	62,86	70,20
Roma Sari Gandum Sandwich Coklat	7,29	69,39	62,45	63,67
Slai O'lai	6,93	76,33	64,08	71,02
Wonderland Biskuit Kelapa	6,55	47,35	52,24	60,82
Oreo	5,97	72,24	77,96	71,84

Based on the Pearson correlation test in Table 3, it can be seen that there is no significant correlation between the average percentage of fixation to the percentage of recall, likeability, and suitability. This is evidenced by the Pearson Correlation between the average fixation of recall, the average fixation of likeability, and also the average fixation of the suitability is negative and also the value for  $p$ -value for each variable. Based on the interval scale for Pearson correlation figures between the average fixation of recall and suitability have a weak correlation, while for the average fixation of suitability has a very weak correlation.

**Table 3.** Pearson correlation results eye tracking variables to questionnaire variables.

		Average Fixation [%]	Recall [%]	Likeability [%]	Suitability [%]
<b>Average Fixation [%]</b>	Pearson Correlation	1	-0.298	-0.231	-0.073
	Sig. (2-tailed)		0.202	0.327	0.761
	N	20	20	20	20
<b>Recall [%]</b>	Pearson Correlation	-0.298	1	0.671**	0.572**
	Sig. (2-tailed)	0.202		0.001	0.008
	N	20	20	20	20
<b>Likeability [%]</b>	Pearson Correlation	-0.231	0.671**	1	0.726**
	Sig. (2-tailed)	0.327	0.001		0.000
	N	20	20	20	20
<b>Suitability [%]</b>	Pearson Correlation	-0.073	0.572**	0.726**	1
	Sig. (2-tailed)	0.761	0.008	0.000	
	N	20	20	20	20

The relationship between these variables is not significant due to many factors, one of which is the brand familiarity factor [4]. This causes a bias when the respondent fills out the questionnaire, so the results of the questionnaire are inconsistent and do not match the results of eye tracking. When the respondent evaluates the questionnaire on the likeability variable, the brand familiarity factor plays an important role in the following evaluation process, which is that the respondent often gives high ratings of biscuit products to the research instrument because of the level of product popularity, the taste of the product, and many other factors.

However, for recall and likeability variables, based on correlation testing as in [8] there was a significant correlation and the level of correlation was strong. This was also proven by several products that were successfully recalled by respondents, namely Ovaltine (81.22%) and Better (77.14%) were the products with the highest percentage of likeability. Therefore, it can be concluded that the products in the memory of the respondents are also the preferred products in terms of packaging. Then the recall variable with suitability is proven to have a significant correlation and has a moderate level of correlation. This is evidenced by several products such as Ovaltine (79.59%), Slai O'lai (71.02%), and also Better (70.61%), which are some of the products rated by respondents as having a high level of conformity for product categories biscuits in terms of packaging and also managed to be recalled by respondents. Therefore, it can be concluded that the respondent's assessment of the product in terms of packaging is appropriate, bearing in mind that the product which is in the consumer's memory is a product with a high suitability rating in terms of packaging.

In addition, for the variable likeability to suitability is proven to have a strong correlation. This is evidenced in some biscuit products favored by respondents having a high level of conformity assessment, namely Ovaltine (79.59%), Oreo (71.84%), Biskuat Coklat (71.43%), and also Better (70, 61%). Therefore, it can be concluded that the respondents' appraisal of the biscuit product in terms of packaging is also a product that is preferred by respondents. Thus, products that are given a high suitability value in terms of packaging are also products that are preferred by respondents in terms of packaging.

After that the product design and development process is carried out, while the needs of consumers usually obtained through direct interviews, but in this study the needs of consumers are obtained from the interpretation of the results of eye tracking along with the questionnaire. Table 4 summarizes the consumer needs and their metrics. Consumer needs related to an attractive packaging concept is found in the results of a post exposure questionnaire about likeability which shows that a particular product is an attractive product design concept.

**Table 4.** Customer needs, engineering metrics, & units.

Customer Needs	Metrics	Units
Attractive packaging concept	Color selection	-
	Packaging size	Cm
	Font size	Pt
Brands are easily seen & contrast	Font color	-
	Font type	-
	Image size	Cm
Attractive product image	Image color	-
	Packaging form	-
Packaging form adjusts the shape of the biscuits	Basic packaging material	-

Consumer needs related to product brands are easily seen & contrast is obtained and also attractive product images are obtained from eye tracking results. Consumer needs regarding packaging form adjusts the shape of the biscuits obtained from the suitability assessment of the results of the post exposure questionnaire.

After obtaining the list of consumers' needs, a questionnaire was distributed to 10 University of Surabaya students to measure the importance of existing consumer needs and the results were obtained that the most important requirement was an attractive packaging concept and followed by a product brand that was easily seen and contrasted, images of products, and the shape of the packaging matches the shape of the biscuit. After that the weighted score is calculated as one of the requirements for the preparation of House of Quality (HOQ), as shown in Figure 1. The product concept is shown in Figure 2.

Based on the HOQ design, the most important metric (having the highest relative weight percentage) is the packaging size. It's just that in this study other metrics such as color selection, font size, font color, font type, image size, packaging form, and basic packaging materials are also included and used as considerations for designing attractive packaging designs for consumers. According to the results of the questionnaire, products that have a conformity assessment in terms of packaging according to respondents are Ovaltine products, so the basic metrics related to the shape and basic ingredients of the packaging are obtained from the recommendations on Ovaltine products and the form of packaging design used is the shape of the tube with the basic ingredients of the packaging being in the form of metallize paper.

In the selection of basic colors of packaging and packaging size obtained from the results of the post exposure questionnaire on the likeability variable, the results taken are regarding the level of interest of respondents in the product in terms of packaging. Similar to the results of the questionnaire on suitability variables, Ovaltine is a product that is preferred by 11 out of 50 respondents when compared to 19 other products, so the basic color of the packaging is orange and can hold 13 biscuits with a net weight of 130 grams.

Font color refers to the analogous color harmony theory, if the packaging is orange then the contrasting color is light orange to yellow. Then for the type of font using fonts that have no legs and separate letters to make it easier for consumers to see and read the elements on the packaging. Then the font size for the product brand is calculated according to what was formulated by Kusumo, et. al. [11] and the reading distance is 5 meters, namely letters height of 3.8 cm, width of letters 2.533 cm, distance between 2 letters 0.76 cm, distance between 2 words 2.533 cm, and distance between 2 lines of sentence 3.8 cm. While the metrics regarding the color of the image are selected based on the results of eye tracking and also the results of the questionnaire variable likeability, namely chocolate biscuits with chocolate jam. Detailed image size is 4.5 cm high image, because the shape of the image is square, the width is 4.5 cm equal to the length.

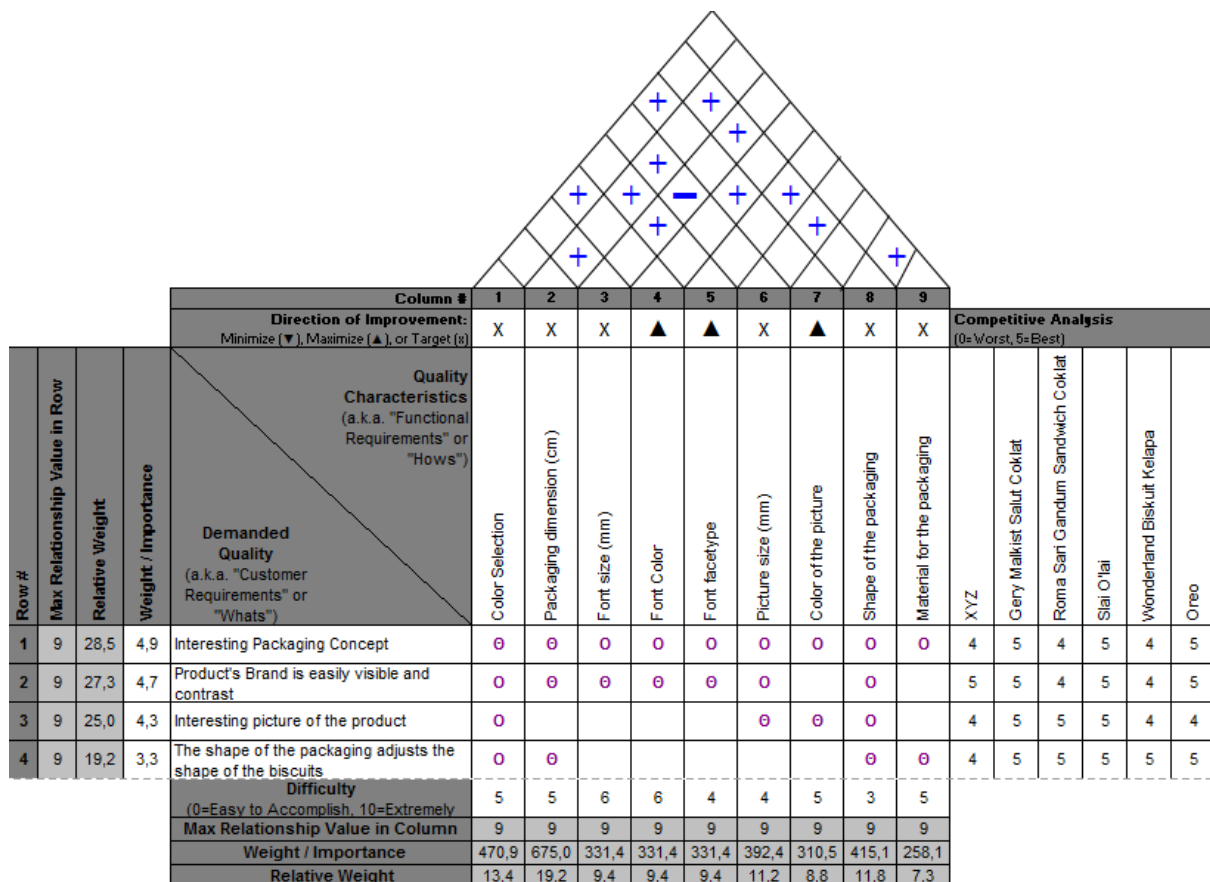


Figure 1. House of quality product packaging design.



Figure 2. Product packaging looks overall blanket tubes.

After obtaining the product packaging concept in Figure 2, a concept test was carried out by distributing questionnaires to 10 respondents regarding the level of packaging fulfillment to consumer needs. The results state that the level of fulfillment of the needs of the packaging is above average, namely the level of fulfillment of attractive packaging concepts (80%), brands are easily seen and contrast (88%), attractive product image (78%), and packaging form adjusts the shape of the biscuits (88%). Figure 3 displays the appearance of the front and back packaging design.






**Figure 3.** Product packaging front view (left) & rear view (right).

**Table 5.** Detail types and font sizes on the package.

Viewpoint	Element	Font Type	Font Size [pt]
Front	XYZ (brand)	Supercraft	108.9
	Net weight	Helvetica Neue	14.2
	EST (company logo)	Arcon	28.4
Rear	XYZ (brand)	Supercraft	56.7
	Nutritional value information	Helvetica Neue	Title : 8.5
			Content : 8.5
	Ingredients	Helvetica Neue	Title : 15
Content : 8			
	Number below the barcode	Courier	8

**Table 6.** Detail image size on the package.

Viewpoint	Element	Image	Size [cm]	
			Length	Width
Front	Image of a biscuit		4.5	4.5
Rear	Image of a biscuit		3.5	3.5
	Barcode		4	2.5

In addition, after the packaging design display is obtained, the details of the image size and font type and size used in the packaging design are shown in Table 5 and Table 6. However, there are differences in the size of the biscuit image located on the front and back, this is because the front is a priority area so it is made with a larger size and has a reading distance of about 5 meters according to calculations according to Kusumo, et. al. [11]. In addition to the size of the barcode adjusted to the size of the existing packaging, so it can meet the available space.



#### 4. Conclusion

This research exposed respondents to a visual of 20 different biscuits packaging and the visual response were recorded through eye tracking device. It is found that among the 20 brands, the most visually sought were Gery Malkist Salut Coklat, Roma Sari Gandum Sandwich Coklat, Slai O'Lai, Wonderland Biskuit Kelapa, and Oreo. It is also found that the orange color is a better attention grabber compared to other color. Then for some packaging elements according to respondents such as company name, brand, and product image, it is categorized as important and must be on the packaging.

The eye tracking data reveals that there is no significant relationship between duration of sight at a point (fixation) and brand recall. The brand recall seems to be influenced by other external factors such as brand image and brand familiarity from the respondents. There is a significant correlation observed between likeability and recall which suggest if the respondents liked the brand or product, s/he would likely able to recall the brand during the post exposure questionnaire. There was no correlation found between the variables of eye tracking and the questionnaire variables. The biscuit packaging concept designed based on the eye tracking result is tested to be interesting in terms of visuals, fulfillment of consumer needs is above 70% overall. The drawbacks of this research are that we used familiar products to be exposed to respondents and the respondents were focused on university students which may have influence in the data gathered. To improve the data, it is suggested for further research the selection of products on instruments using foreign products or totally mock-up products so that the respondents do not have prior knowledge of the brands. Demographic expansion can also be done to better understand the customers perception in a wider perspective.

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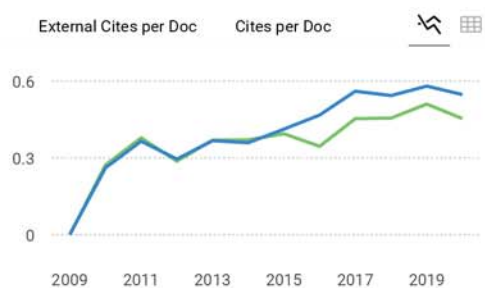
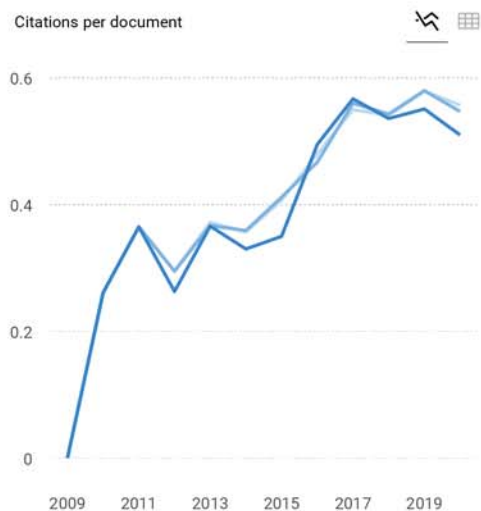
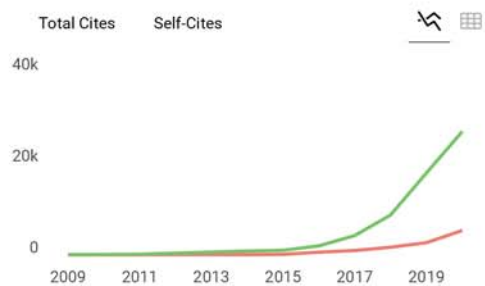
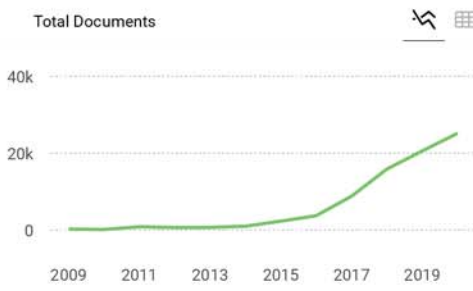
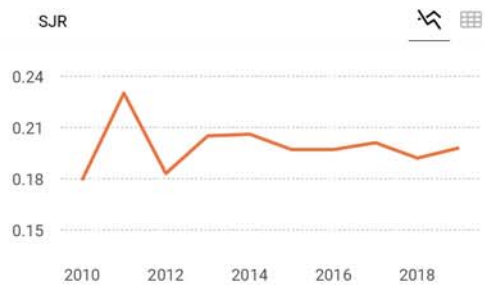
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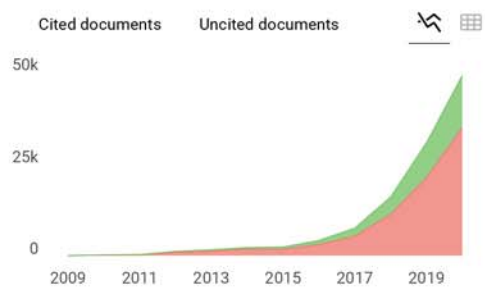
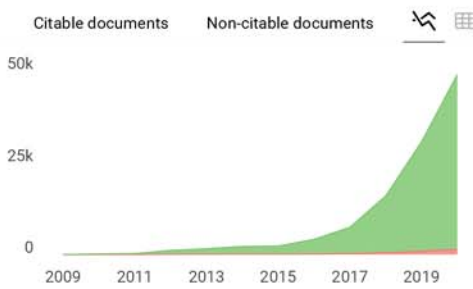
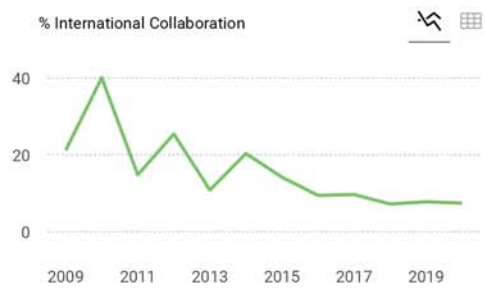
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