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Contribution of Sri Lankan state university staff to knowledge exchange between universities and industry

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Abstract

Many studies have been attempting to solve the existing debate on knowledge exchange between university and industry and the role of the university in the last few years. However, still, inconclusive arguments have been going on the topic. Therefore, the study hopes to spark the burning debate on knowledge exchange between university and industry through academics' contribution. Accordingly, the study organized empirical facts and findings around joint researches, contract researches, human resource mobility, and training that easily knowledge moves from university to industry, and on which finalized the study scope developing four directional hypotheses connecting knowledge exchange process with aforementioned dimensions. First-hand data were gathered through an e-mail survey from the academic staff of national state universities and have them processed through the SPSS software package. Basic descriptive statistics and inferential data analysis tests were employed on the data to assess the academic contribution to the knowledge exchange process. The statistics highlighted that the overall involvement of academic staff in joint works, contract works, human resource mobility, and the training with industry are very low in Sri Lanka. The regression results of the study confirmed the significant impact of joint research works and training on the knowledge exchange process between universities and industry in the Sri Lankan context. Thus, universities should develop a more flexible and convenient policy package to promote joint research work and training to uplift the contribution of academic staff into industry matters effectively.

Keywords: *Contract research, human resource mobility, joint research, knowledge exchange, training.*

1. Introduction

Universities are institutes that perform a key role within contemporary society educating a larger proportion of the population (Perkmann et al., 2012). Indeed, publicly funded universities and their researches must have a profound impact on the economy and national development addressing scorching economic and social issues (Balconi, Brusoni, & Orsenigo, 2010). However, universities in the past have witnessed failing in accomplishing the underline principle of knowledge exchange at a commercial level, thus businesses have to have their own in house research mechanism for knowledge generation and self-development (Lee, Hwang, & Choi, 2012). With times, not long ago, internal research and development capability of business firms became a camouflaged vein for fierce competition and competitive entry. Accordingly, a company, which is financially and technically strong, could beat any rivals in the business, however, that was not always fair to strangers and start-ups, which was a major competitive threat for economies. The paradigm of open innovation changed everything in which former leading industrial enterprises confronted remarkably strong competition from many new companies and star-ups (Chesbrough, 2012), with transferring science and technology across boundaries of organizations. Now, it is noticeable that firms do not encourage much in house research competencies, albeit existing attempts extensively relying on the external source of knowledge and researches (Howells, Ramlogan, & Cheng, 2012; Siegel, Waldman, & Link, 2003). This paradigm shifts enabled universities to commercialize knowledge at a cost of the industry with a profit. Accordingly, under open innovation, universities should think of breaking its traditional vein of protective sentiment and waving friendly hands to industries for mutual benefits. Consequently, a notable trend recorded everywhere is that many, not all universities have taken considerable effort to develop a "third mission" (Perkmann et al., 2012; Razak & Murray, 2017) for a collaborative journey with the industry. It confirmed universities have been undergoing the process of change towards where scientific knowledge can be effectively commercialized through patents and licensing.

University name itself gives the meaning of openness, hence by nature university is open to everyone (Poyago-Theotoky, Beath, & Siegel, 2002), and is not confined to its boundary to anyone who is in and is expected to be in. The sky is the boundary and horizon is the limit of the university, therefore unless and until one has his psychological boundary, no one has defined correctly limit of the university. This open nature of the university is a blessing to open innovation where knowledge can easily flow between the boundaries of organizations. Very often, universities make their scientific output freely available with the aim that it would be picked up by researchers for further development or industry for application (Striukova & Rayna, 2015). Moreover, university researches often address real industrial issues that have been scorching the long run, in particular, research output may be a form of new product, service or business process that can be commercialized through patent and licensing.

The knowledge exchange between university and industry may take different forms. The most common transfer channels are conferences, meetings, publications, contact researches, collaborative researches, co-supervising, industrial PhDs, consultancies, informal conversations, and supports (Jonsson et al., 2015). Academics play an important role in this process sharing knowledge through researches, consultancies, training, supervising, and so on. When they are active and forward in the process, knowledge movement is alive and worthwhile. Accordingly, it is worthwhile to assess their support for the knowledge exchange process in an open innovative ecosystem. The research problem of the study was how to do and to what extent, academics contribute to university-industry knowledge exchange in Sri Lanka. Thus, the primary focus was given to explore the contribution of academic staff to the knowledge exchange process with industry in Sri Lanka. Accordingly, the present study will be significant in many ways. First, this is the first systematic study that describes the industry-university relationship in Sri Lanka. Hence, the study would be a great support and be a platform for policymakers and industry delegates to promote future collaborative engagements in the economy. Second, the study explored to what extent academics contribute to the knowledge exchange process would provide a more accurate picture of present knowledge movement in the economy through universities.

The paper is structured to give an idea about the university-industry knowledge exchange process so that section two of the paper briefs theoretical base and empirical findings around the topic. The road map and techniques used for the study are discussed in section three, and section four is used for the data analysis. The fifth section is detained for discussion and recommendations.

2. Literature review

Open innovation is defined as the purposive use of inflows and outflows of knowledge to accelerate internal innovation and expand the markets for external use of innovation (Chesbrough, 2012). It may take place in three different ways (Gassmann & Enkel, 2004) as inside-out innovation, outside-in innovation, and mixed innovation. Inside-out innovation focuses on commercializing internal knowledge through patents and licensing rather than waiting on own internal paths to the markets (Striukova & Rayna, 2015). Outside-in innovation absorbs external knowledge flows to foster internal research and development activities. In this process, customers, suppliers, competitors, cross-sector companies, universities, and research institutions are considered as potential sources of ideas (Chesbrough, 2003). The last type of process is called the "coupled process", which is the combination of both inside-out and outside-in innovation (Striukova & Rayna, 2015).

Before the open innovation, knowledge exchange existed between university and industry. Single European Act (1987) promotes university-industry collaboration (Striukova & Rayna, 2015) and Nonwovens Cooperative Research Center established in 1991 as National Science Foundation (NSF), State-Industry-University Cooperative

Research Center (UIDP, 2014) evident past knowledge-based interactions. However, many of former relationships were often government-led or result of public policies (Zinck & Newen, 2008) rather than the real requirement of knowledge exchange. University-industry collaboration brings many advantages to both entities. For the industry, it provides access to technology, fresh knowledge, qualified graduates, specialized talents and networks (Lee, Hwang & Choi, 2012), facilitates research and development, human resource mobility, innovative solutions, collaborative publications (Lee et al., 2012; Perkmann & Walsh, 2007). In return, the university will benefit from attracting funds for research, accessing real data and modern equipment, familiarizing with industrial science and technology, supplementary income (Blackman & Segal, 1993). Further, it reinforces academic entrepreneurship, university spin-offs, and application of academic researches (Lee et al.,, 2012; Perkmann & Walsh, 2007). Instead of the aforementioned advantages, there are several demerits have been discussing at many academic forums. For the industry, there is a big risk if any sensitive information leaks to competitors, if core business activities outsource through the collaborations (Dahlander & Gann, 2010), and it is a challenge to capture the benefit from external knowledge and maintain long-term relationships with several parties simultaneously. Moreover, innovating with partners not only share risk but benefit too. To university, external engagement significantly deteriorates the research agenda of scholars (Blumenthal et al., 1996).

2.1 Types of university-industry relationship

In a competitive environment, knowledge can be moved between university and industry in different manners. According to Ahrweiler, Pyka and Gilbert (2011) and Feldman and Baba (2015), the relationship can be either formal, informal or both. The formal relationships include licensing of patents, academic spin-offs, contract research, collaborative research, counseling (Perkmann et al., 2012), co-publications, mutual secondments, and employment of graduates, that based on a signing a legal agreement between the entities (Padilla-Melendez & Garrido-Moreno, 2012). In contrast, activities such as informal meetings, consultancies, lectures and conference participation, and ad-hoc advice can be identified as informal relationships (Ahrweiler et al., 2011). These informal interactions may purely be based on personal connections and interpersonal relations of each party (Melese, Lin. Chang, & Cohen, 2009 ; Perkmann & Walsh, 2007). Moreover, these interactions can be segregated as industry-full connection and university-push interaction (Poyago-Theotoky et al., 2002). As per Schartinger, Rammer, Fischer, and Fröhlich (2002), the interaction between academics and industry has grouped into four: Joint research, Contract research, Human resource mobility, and Training. These interactions could be seen both at individual and institutional levels. All types of knowledge interaction between university staff and firms could be arranged based on the degree of formalization, suitability to transfer tacit knowledge, and personal contact as follows.

Table 1
Types of knowledge interactions between university and firms

Types of knowledge interaction	Formal interaction	Transfer of tacit knowledge	Personal contact
Employment of graduates by firms	+/–	+	-
Conferences or other events with firm and university participation	-	+/–	-
New firm formation by university members	+	+	+/-
Joint publications	-	+	+
Informal meetings, talks, communications	-	+	+
Joint supervision of Ph.D. and Masters theses	+/-	+/-	+/-
Training of firm members	+/-	+/-	+
Mobility of researchers between universities and firms	+	+	+
Sabbatical periods for university members	+	+	+
Collaborative research, joint research programs	+	+	+
Lectures at universities, held by firm members	+	+/-	+
Contract research and consulting	+	+/-	+
Use of university facilities by firms	+	-	-
Licensing of university patents by firms	+	-	-
Purchase of prototypes developed at universities	+	-	-
Reading of publications, patents, etc.	-	-	-

+: interaction typically involves formal agreements, transfer of tacit knowledge, personal contacts;
+/-: varying degree of formal agreements, transfer of tacit knowledge, personal contacts;
-: interaction typically involves no formal agreements, no transfer of tacit knowledge, no personal contacts.

Source: Extracted from Schartinger et al., (2002, p. 302)

This study mainly focuses to assess the academic contribution to knowledge exchange between university and industry. The term academic contribution is used here to describe all types of direct, indirect, codified, non-codified, personal / official, formal/informal engagement of academic staff to transfer knowledge and science between the university and the industry. Knowledge interaction is measured by the side of the industry and the side of the university (Schartinger et al., 2002). This study, the university side is chosen as a study area. Having considered the nature and types of relationships a university had with industry, the current study focused its investigation along key dimensions which disclose all types of knowledge interactions and well express the contribution of academic staffs are joint research, contract research, staff mobility and training (Schartinger et al., 2002).

3. Methodology

The study aimed to explore the contribution of academic staff to university-industry knowledge exchange in Sri Lanka through four directional hypotheses, therefore by nature study was quantitative and explanatory. The study applied the deductive research method and questionnaire survey strategy. A conceptual framework was developed through the literature review in which joint research, contract research, staff mobility, and training were identified as the independent variables and knowledge exchange as the dependent variable. All the academic staffs attached to state universities were the population and 425 respondents were selected as the sample randomly. The study reached the sample through a standardized questionnaire. The questionnaire had three sections. Section one contained the short answer questions related to respondents' demographic information such as the university, faculty, age, gender, research focus so on. Section two included a set of Likert scale questions to measure four independent variables. The questions related to joint research, contract research, human resource mobility, and training were managed through previous studies. Here, studies of Kitson and Hughes, 2010; Scandura, 2016; Ankrah and Al-Tabbaa, 2017; Schartinger et al., 2002; Padilla-Melendez and Garrido-Moreno, 2012; assisted a lot. The last section included standard questions developed by Kitson and Hughes, (2010), albeit a few questions had to alter as suitable to the Sri Lankan context. This cross-sectional study collected data from 15th May 2019 to 31st July 2019. Face and content validities of the questionnaire were ensured, being evaluated by two senior academics of the Rajarata University of Sri Lanka. The alpha test was used for reliability measurement. The study mainly employed descriptive statistics, correlation, and regression analysis to test developed hypotheses.

4. Results and discussion

A study distributed a questionnaire to the sample academics through e-mails, but only 178 had responded. Based on the return questionnaires, the study checked the test reliability through the Alpha coefficient.

Table 2
Reliability results

Variable name	Numbers of items	Alpha value
Joint Research	06	0.889
Contract Research	07	0.874
Human Resource Mobility	07	0.780
Training	06	0.906
University-Knowledge Exchange	08	0.773

As per table 2, the alpha coefficient of each variable was greater than the threshold value (0.7), and it indicated that the questions included in the questionnaire are not biased. That was ensured consistent measurement across time and the various items in the instrument.

4.1 Sample profile

The sample represented all the state universities. Out of the respondents, 25% of them were from the University of Sri Jayewardenepura. The responses from the Universities of Rajarata, Sabaragamuwa, Peradeniya, and Moratuwa were 18%, 14%, 14%, and 9.6% respectively. The responses from the university of Vavuniya, Wayamba, and South Eastern were very low compared to the other state universities. As per table 03, the study fairly represented both genders. Around 45.5% of respondents are male, and 54.5% are female, and both groups belonged to all grades of staff; 2.2% are Senior Professors, 7.9% are professors, 59.6% are Senior Lecturers, and 30.3% are Lecturers. In terms of qualification, 43.8% of respondents had Ph.D. qualifications and 14.6%, 36% qualified M.Phill, and Master Degrees respectively. An area of specialization was identified, along with the academic faculties he/she serves to. The majority of the respondents were from the Management and followed by Medicine and Science Faculties. The lowest contribution was reported by the Faculty of Technology. 40% of respondents joined universities just after graduation without proper industry experience and, 6.2% of respondents have experience in charitable organizations. Only 34.8% of respondents have working experiences in either small and medium or large-scale public or private sector organizations.

Table 3
Demographic statistics

Category	Percentage
Gender	
Male	45.5 %
Female	54.5 %
Job title	
Senior Professors	2.2 %
Professors	7.9 %
Senior Lecturers	59.6 %
Lecturers	30.3 %
Qualifications	
PhDs	43.8 %
M.Phill	14.6 %
M.Sc./ MBA/ MA	36 %
BA/ B.Sc.	5.6 %

4.2 Overview of the variables

Joint research activity for the study means that a collaborative research works of an academic with the industry, aiming to develop an existing/new product, service, business process, best practices or solve the problems of the industry, and was measured through five Likert questions range from one to five. As per table 04, the overall mean value for the joint research activity is 2.479, and the standard deviation is 0.924.

Accordingly, the level of joint research activity of academic staff is very low in the Sri Lankan context. This lower collaboration has captured due to the lower connection of academics with industry as a means of improving the product, service, and business processes. The deeper analysis found that 44% of respondents had never been joining with external organizations for knowledge exchange. Though many respondents have been engaging in applied type research works, only 13.4% of them often connect with industry for joint research works. Those factors have lowered the collaborative research works of academics with industry.

Contract research is a paid-service performed by university researchers for external organizations on a contractual agreement. The study measures degrees to which an academic has such contractual agreements for knowledge sharing with industry. Table 04, indicated that the overall mean value of contract research is 2.042, and the standard deviation is 0.773. It demonstrates that respondents maintain a minimum level of contractual agreement with industry for research and knowledge sharing. The detail exploration of the contractual research works found that 63.8% of respondents had never taken industrial assignments and research on contract. Consequently, very rarely industry too had called them for industrial assignments. Business proposal development, work for a patent, product/process improvement, feasibility study, and business project partner are the most popular paid contractual activities that academics engage in his/her career. However, the survey indicated that more than 68.9% of respondents have never involved in any contractual activity in their careers. Further, it was noticed that academic are not willing to transmit knowledge on price and has lowered motivation of academic to contractual work. However, many respondents have been working for external institutes, as consultants and been persuading students for commercial consultancies were noted through findings.

Table 4
Descriptive statistics of variable

Variable	Mean Value	Standard Deviation
Joint Research Works	2.479	0.924
Contract Research Works	2.042	0.773
Human Resource Mobility	2.229	0.796
Training	2.447	1.031
Knowledge Exchange	3.579	0.733

Human resource mobility between university and industry is the most productive way of transferring non-codified knowledge among organizations. The descriptive statistics indicated that overall mean value as 2.229, and the standard deviation 0.796 indicating slight positive progress of the variables compared to the previous two. Accordingly, human resource mobility between industry and university actively exists at an average level. Though academic staff did not have the executive level of experience in the business world, many students have jobs found in industry, and industry people have started higher studies the recommendation of academics.

Training is recognized as an effective source of transferring knowledge which resides in one's mind that cannot be codified into a physical format. On the job training is not always adequate to upsurge the required skills of employees, training, therefore, is considered an effective mechanism to develop employees' strategic competencies. Six Likert questions were used to measure the level of staff involvement for employee/student training at industry/university in the knowledge exchange process. The overall mean and standard deviation of the variable are 2.447 and 1.031 respectively as per table 04. It indicates that the level of staff involvement in training activities is average. Often academics actively involved in many trainings activates as a means of resource person for workshops and training sessions. Further, through personal connections, academics brought industry experts for undergraduates training. Those factors have swelled the training level into the average position in Sri Lanka. The most popular students training method found here was that field visits and industry tour.

4.3 Correlation test

As exhibits in table 05, joint research, contract research, human resource mobility, and the training display positive correlation coefficients with the knowledge exchange process. Their respective significance values are also lower than 0.05 level. Accordingly, it can be concluded that all independent variables have statistically significant positive associations with the knowledge exchange process in Sri Lanka. Findings aligned with many previous studies (Ankrah & Al-tabbaa, 2017). The most important part of this survey is to measure the impact of individual variables on the knowledge exchange process. Four directional hypotheses that were developed upon previous literature were tested by regression analysis. The regression results were reported below.

Table 5
Correlation results

Variable	KT	JR	CR	HRM	TR
Knowledge Exchange (KE)	1				
Joint Research (JR)	.641**	1			
Contract Research (CR)	.571**	.680**	1		
Human Resource Mobility (HRM)	.515**	.550**	.635**	1	
Training (TR)	.627**	.714**	.698**	.623**	1

***Correlation is significant at the 0.01 level (2-tailed)*

As per table 06, the R square value is 0.485, and the ANOVA significance value is 0.000. R square value exhibits that the regression model can predict a 48% variation of the knowledge exchange process through joint research, contract research, human resource mobility, and the training. The value is reasonable and acceptable for studies. R square value above 30% (Sengupta & Ray, 2017; Scandura, 2016), is used for accurate prediction in research studies. The predictive power of the overall model is good as ANOVA tests got significant. Durbin Watson statistic is 1.884 and, it is very close to

threshold value 2. It assures the absence of heteroscedasticity in the data set. Multicollinearity problem among independent variables was checked through collinearity statistics. Variance Inflation Factor recorded its maximum of 2.649. It was less than 10, and respective tolerance values were greater than 0.1. Both measurements assured the non-existence of multi-collinearity among variables.

Table 6
Regression result

R Square .485	Adjusted R Square .473	ANOVA Sig. 0.000
Durbin Watson 1.884		

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error				Tolerance	VIF
(Constant)	1.974	.137		14.445	.000		
Joint Research	.264	.066	.334	3.990	.000	.424	2.359
Contract Research	.091	.080	.098	1.136	.257	.401	2.491
Human Resource Mobility	.103	.068	.114	1.526	.129	.531	1.884
Training	.183	.066	.248	2.794	.006	.378	2.649

a. Dependent Variable: Knowledge Transferring Process

The first hypothesis "Joint research has a significant impact on university-industry knowledge exchange process", was tested. As per the test statistics, the regression coefficient of the model is 0.264, and it is statistically significant. Accordingly, the study accepted hypothesis one and confirmed the impact of joint research has on knowledge exchange between university and industry in Sri Lanka. Many previous studies have confirmed the collaboration between firms and universities (Howells et al., 2012). The deeper exploration of statistics indicates that more than 50% of respondents have connected industry for at least one joint knowledge-sharing activity. The proportion of academics in an Engineering discipline is significantly higher in the process than in other groups. Academics from Management disciplines obtained the second position in joint activities with industry. The lower joint activities are shown by the Medical discipline. Interestingly, not a surprise, but the reality is that the Technology discipline has very little collaboration with industry at this movement, as strangers to the field of higher education in Sri Lanka. To conduct Engineering, Management, Science, and Agriculture research work more accurately, academic must-have lucrative collaborations with industry. Therefore working with industry is likely to be highly complementary with academic research performances (Balconi & Laboranti, 2006).

Contractual agreements between academics and external institutions formalize and facilitates for movement of codified knowledge between university and industry that exists earlier in hidden, is tested through hypothesis two. The variable is not significant, hence the study does not accept hypothesis two: Contract research has a significant impact on the university-industry knowledge exchange process, confirming that the impact of contractual research work for knowledge exchange in Sri Lankan is not significance. Study findings align with many previous insights too. Though contract research activities have significant in many previous studies as a knowledge transfer (Perkmann et al., 2012; Ankrah & Al-tabbaa, 2017), practically firms interact less with universities (Schartinger et al., 2002). However, it was evident in the study that nearly 70% of respondents had not entered contractual agreements with external institutes as knowledge professionals. This lower inclination for contractual works significantly lowered the contribution it has to knowledge exchange. Consequently, only less than 7% of respondents in Sri Lanka, earn more than 10% of the income of their monthly salary through contractual agreement, and the amount is very below comparing to academics in other nations.

Human resource mobility between university and industry is at present considered as a most productive way of transferring non-codified knowledge among organizations, was tested through hypothesis three: Human resource mobility has a significant impact on the university-industry knowledge exchange process, was statistically insignificant in Sri Lankan context. This lower human resource mobility was caused due to less participation of academic staff for business activities as consultant, observers and business auditors. Findings do not fully support for previous studies. Schartinger et al. (2002), pointed out that mainly in services, personnel mobility, and training courses for firms are the most important types of knowledge interaction channels.

The regression coefficient of training on the knowledge exchange process is 0.183, and its respective significant value is 0.006, therefore, hypothesis four was accepted. Accordingly, it can be concluded that training has a substantial impact on the present knowledge exchange process of the country between the university and industry. The deeper exploration of the variables found that respondents frequently conducts workshops and training programs to industry people as well as to the graduates Further, it noted that many academics have been joining the industry to design and implement long-term training on the requirements of the industry. Moreover, on personal contacts, the majority of academics (about 68%) regularly take undergraduates to the industry for training. This active involvement has swelled the academic contribution of academic staff to the knowledge exchange process significantly. Many previous studies have confirmed the relationship.

5. Conclusion and recommendation

The objective of this paper was to explore the contribution of academic staff to the knowledge exchange process between the university and industry. As a knowledge

agent, an academic should persuade to lower the gap between what an academic should do from what academics do in the knowledge exchange process. In reality, the gap is fixed and, widening continuously, therefore assessing the contribution of academics to the knowledge exchange process was imperative everywhere. In particular, this paper has aimed at analyzing academic contributions to the knowledge exchange across academics' involvement in joint works, contract works, human resource mobility, and training work with industry. To undertake this purpose, the study collected new and fresh data from university academics through a standardized questionnaire. Four directional hypotheses that predicted the significant effect of the joint, contract, human resource movement, and training to knowledge exchange, were tested through regression analysis.

A study distributed a questionnaire among academies through e-mails. Responses represented all state universities, gender groups, and job categories. The majority of the respondents were from Management Faculties and followed by Medicine, Science Faculties. First, our evidence shows that the overall involvement of academic staff in joint work, contract work, human resource mobility, and the training with industry are very low. This was mainly due to the lower connection of academics with industry as a means of improving the product, service, and business processes. Secondly, it found that academics are not willing to transmit their knowledge on the price to third parties, however, they have been actively involving training and development actives with the industry largely as resource persons for workshops and training sessions. Finally, four directional hypotheses that assess the impact of joint, contract, human resource movement, and training to knowledge exchange, were tested through correlation and regression test. All four independent variables correlated significantly with the knowledge exchange, however, at the regression, contract research and human resource mobility were insignificant. Accordingly, in Sri Lanka, only joint research and training work significantly affect to knowledge exchange process between the university and the industry. Hence, the findings of the study highlight the necessity of having a strong policy framework to uplift the academics' involvement in collaborative works with industry. Secondly, the policies should focus to strengthen the knowledge flow between university and industry through active academic involvement. In this process, it would be more worthwhile to pay much concentration to joint research and training works.

6. Limitation and further research area

Given the nature of the study, some limitation has to be taken into account. First, the study considered only the university side of the knowledge exchange process though it has two main parties as university and industry. Resulting in a room is still vacant for future researchers to consider both sides in the future. Though the study touched one side of the bridge, we firmly believe that some of our findings could spark a debate of knowledge exchange and will be informative for future research activities. Secondly, the study took only joint research, contract research, human resource mobility, and training into consideration when measuring academic contribution through a large pool of

knowledge exchange types are available. Therefore someone who wishes to consider more, have a chance to do.

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