Int. J. Engng Ed. Vol. 24, No. 4, pp. 802–810, 2008
Printed in Great Britain.

0949-149X/91 $3.00+0.00

What is the On-Campus Experience? Engineering Student Study and Work*

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Accreditation for off-campus engineering programmes has proven to be problematic. In Australia, off-campus programmes are compelled to contain mandatory residential sessions so that off-campus students can have an 'on-campus experience'. This paper explores the nature of modern on-campus undergraduate engineering study, and finds that it now typically involves at least part-time employment and has more in common with off-campus study than the on-campus experience enjoyed by most of the current institutional (education and professional) administrators when they completed their undergraduate studies. Rather than ignore student term-time work, engineering programmes should use it to enhance the development of desirable graduate attributes.

Keywords: student attendance; student employment; study and work

INTRODUCTION

TRADITIONALLY, ENGINEERING undergraduate education has been based on full-time, on-campus attendance [1], with a high number of contact hours per week [2], and has changed little in the last 50 years [3, 4]. Accreditation for engineering programmes containing elements of off-campus study has proven to be problematic. In Australia, the engineering professional body that accredits undergraduate programmes is Engineers Australia. Since 1976, Engineers Australia (the current trading name of the Institution of Engineers, Australia—IEAust) has permitted programmes utilising 'external studies'. A sequence of policies relating to external studies programmes has specified the on-campus attendance requirements [5–7]. The latest incarnation of this policy was issued in 2005 as the Engineers Australia Policy on Accreditation of Programs Offered in Distance Mode. As evidenced by the final paragraph of the policy, its contents were strongly influenced by the off-campus model employed by the University of Southern Queensland (one of the two Australian universities, along with Deakin University, with a significant off-campus engineering programme). Item 1.5j of the policy (including Engineers Australia's bold type) is:

> **A programme offered by distance education should include a number of on-campus components** so that the School can ensure that graduates have attained the specified attributes and capabilities. Residential schools enhance student–staff and student–student interactions as well as enriching the learning experiences of both students and staff. Also, although most or all practical experience may have been gained off-campus, it is important that staff be convinced of students' practical capabilities at first hand. [8]

Interestingly, item 1.5, which identifies the points that Engineers Australia will 'particularly look for in evaluating distance-education programmes', also identifies that, 'These are not prescriptive; but where they are not in evidence, the evaluating panel will wish to be convinced the techniques actually in use are equally effective . . .' [8].

So, while 'on-campus components/residentials' will be 'particularly looked for', in theory, alternative approaches that demonstrably achieve the same student outcomes should be acceptable. However, in practice, advice provided by Engineers Australia during the course accreditation process is that they interpret the policy to mean that any external programme of study must include a number of mandatory on-campus components—two weeks for each full-time year of study is the quantum that seems to be acceptable. Although espousing an 'outcomes' focus in its accreditation literature, Engineers Australia seems more interested in specifying 'hours dutifully accumulated', rather than certifying 'demonstrable attainment of specified knowledge and skills' [9]. Time spent in class has traditionally been a key element in defining student participation and mastery of learning content; distance education poses the challenge to define this 'time' in new ways [10].

The 'problem' for accreditation of higher education caused by distance education, and the inability

* Accepted 28 July 2006.

of accreditation systems based on traditional on-campus study models to appropriately address off-campus study without stifling innovation, have been reported for many years, both in higher education generally [10, 11] and specifically in engineering undergraduate education [12–14]. Both national [15] and international [16] engineering accrediting bodies are struggling to make progress on the issue of accrediting off-campus study, in part due to the fact that they are still having difficulty accrediting aspects of on-campus programmes [15]. There are virtually no undergraduate engineering programmes available in the fully off-campus mode, though they were predicted to be available by 2004 in the USA: 'The technology is already there . . . It's a matter of legitimizing it' [15]. This suggests that the formal course accreditation function has acted as a barrier to the development of fully off-campus studies in engineering. If the full-time 'on-campus experience' is so important to the formation of engineering undergraduates, then its nature is worthy of some investigation.

THE MODERN REALITY OF THE ON-CAMPUS EXPEREINCE

In reality, the nature of 'full-time' undergraduate on-campus study has changed radically in the last two decades and this change has been felt internationally. The increase in student term-time employment has paralleled the decline in state support of higher education and the shifting of more of the cost of higher education to students; this is reported in the UK [17–23], Australia [24–26] and New Zealand [27]. The reported average hours per week of term-time student employment varies, but is significant. Little reported that in 1998/99 46% of full-time UK students worked on average 11 hours per week and in 2000 60% of students worked up to 10 hours per week, and 13% were working 20 hours per week or more [18]. Curtis and Shani, based on a survey of 359 full-time undergraduate students at Manchester Metropolitan University, reported that 55% of students worked in 2000 (a 28% increase over the previous year) and that University of Brighton students in 1993 worked on average 15 hours per week, with 85% working more than 10 hours per week and 30% working more than 20 hours per week [23]. Metcalf reported on a survey of third-year students at four UK universities in 2000/1, finding that 46% of students worked during term-time and the median term-time employment was 12 hours per week [17]. Oakey *et al*. reported on a survey of 291 students drawn from across the University of Salford, where it was found that 54% of students worked at least part time, the mean hours per week of work reported was 16.7 hours, the median was 16 hours per week, and the range of reported hours of work per week was 3–35 hours [19]. Anderson-Rowland surveyed 514 commencing engineering students in 1995–1996 at Arizona State University and found that 55% of all commencing students were employed, and 25% of students were working more than 20 hours per week [28]. Long and Hayden, in a survey of more than 30,000 Australian undergraduate students in 2000, found that 70% of students (65.8% for engineering) had employment during the semester (a 50% increase since 1984) and the average hours worked per week was 14.5 hours (a three-fold increase since 1984) [24]. McInnis and Hartley, based on a 2001 survey of 1563 working Australian undergraduate students, found that the average hours per week of work was 14.7 hours (13.7 hours for engineering) [25].

For many students, term-time work is no longer a 'choice' but a necessity. In the UK, there is evidence that student debt increased dramatically in the 1990s, that student work is increasingly 'essential, rather than incidental, to student finances' [20] and that most students already have paid employment by the time they reach university [22]. The principal reason for UK university students taking paid work is the cost of their education [23], and students from less well-off backgrounds are working the most [18]. In Australia, more than half of students studying part time would prefer to study full time but are unable to due to the need to work, and many students are compelled to take part-time work simply to remain in their studies [24]. For 75% of Australian students with term-time employment, paid work was their main or only source of income during the university year [25]. Similar information about increased student financial pressure due to the rising costs of education and the consequent need to balance part-time work with undergraduate study is reported in New Zealand [27].

While student work in the UK (and elsewhere) is not new, it is beginning to impact on student study habits [19]. It is reported that the main reason for student drop-out in the UK is financial pressure [21, 23]. Term-time working is linked to lower academic success—affecting attendance at lectures, production of assignments and time available for study. In a survey of four UK universities, Metcalf found similar results at each institution and, overall, for students with term-time employment, 64% had difficulty or great difficulty in combining work and study and 77% indicated that work impacted on their study [17]. Anderson-Rowland found that, of the 55% of commencing engineering students at Arizona State University that were employed, the mean study-plus-work commitment of these students was 60 hours per week and that for some students this commitment was in excess of 100 hours per week, clearly indicating that many students were over-committing themselves to work and school [28]. Long and Hayden found that 10% of Australian working students frequently miss classes, that work seriously affects 20% of working students and that 20% of students with dependants miss classes due to financial constraints [24]. Of the

70% of Australian undergraduate students that work, more than one-third were prepared to miss lectures, 40% indicated that work gets in the way of their academic studies, 70% indicated that their social life was mainly away from the university and 57% spent limited time on campus other than for classes [25]. In New Zealand, it is recognised that, due to students working, few students are on campus at any one time, and the emphasis on face-to-face teaching is declining [27].

Student employment, in many places, is now an almost universal experience, with many students already employed when they come to higher education. This is not simply a 'student problem' or the concern of a small minority. Student work has an impact on study, but whether this is positive or negative may rest largely on the response (or lack of response) of higher education institutions. At a national level, simply allowing students to drop out of higher education due to financial/work pressures is an inefficient and wasteful use of scarce education resources [21, 23]. Working can provide real benefits (experience, confidence, skills, etc.) to students [23], and the UK government promotes opportunities for higher education students to undertake work to assist them in the transition from education to work [18]: 'Indeed, graduates who do not have a history of employment . . . are likely to be at a disadvantage in the job market' [25]. At an institutional level, responses have varied. In the UK, some universities have established 'job shops' to assist students to find work [18, 21], through to developing 'processes by which students might be helped to recognise in an explicit way learning derived from experiences of working' [18]. In Australia, McInnis and Hartley note: 'An increasing number of services at universities are being offered out of business hours, such as counselling and financial services' [25]. While institutions familiar with the needs of part-time students regarding work and study may be comfortable granting special consideration to part-time students, traditionally they may not have been so understanding with 'full-time' students. Now that work and study are the norm for many full-time students, it may be that the same consideration will have to be granted more universally to all students [23]. In the Australian study *Managing Study and Work*, the authors suggest:

Our title . . . is directed to both students and universities. It reflects a belief that the new realities of study and engagement with university are not just matters for individual students but also present universities with a set of circumstances that require strategic management . . . Study is only one area of life, an area that has to be juggled along with other important areas such as paid work, relationships and leisure activities . . . In our view students are now in a powerful position to shape the undergraduate experience to suit their own timetables, including work and lifestyle priorities . . . Institutional responses need to address, in the context of changing student expectations and realities, the question of how the educational experiences of students can be structured to enhance the learning outcomes that universities value. [25]

These comments could also be applied to other institutions that have a stake in the education process, including the professional bodies that accredit undergraduate professional programmes. If Engineers Australia has a concern that off-campus students have a limited 'on-campus experience', then this concern should also extend to on-campus students!

Engel, in an analysis of a sub-set of the more than 30,000 Australian student data set in the survey conducted by Long and Hayden, specifically looking at results for students of the Australian National University, found some differences in results at the institutional level [26] and Long and Hayden found differences in results between courses/disciplines. This paper seeks to quantify the nature of the 'on-campus experience' for engineering and technology students at Deakin University in Australia.

METHODOLOGY

To quantify the nature of the 'on-campus experience' for engineering and technology students at Deakin University, a survey of all current (in 2004) Deakin engineering and technology students (730 students) was undertaken seeking information about their work and study habits. The survey was undertaken by a postal questionnaire that sought the students' responses to the following:

- demographic information—age, gender, mode of study and rural/isolated status;
- average hours per week in paid employment;
- average hours per week spent in lecture and tutorials;
- average hours per week spent in laboratory and practical work;
- average hours per week spent in private study at home; and
- average hours per week spent on campus outside of formal classes.

As required by the Deakin University Human Research Ethics Committee, the questionnaire was anonymous and voluntary. A significance level of 0.01 was used for all parametric statistical tests.

RESULTS

Response rate and demographic information

Table 1 presents a summary of the survey group response rate and demographic information. The gender, course of study, mode of study and 'rural and remote' status characteristics of the entire commencing class group were known, permitting

Table 1. Survey group demographic information

Number of valid responses	Total student enrolment		Response rate
145	730		19.9 per cent
Mean age	Standard deviation	Age range	Median age
30.4 years	8.5 years	18 to 48 years	30 years
Characteristic	Respondent sample	Class population	Chi-square test
Female	7.6 per cent	9.2 per cent	
Male	92.4 per cent	90.8 per cent	$\chi^2_1 = 0.38$, $p > 0.53$
Bachelor of Engineering	69.7 per cent	74.0 per cent	
Bachelor of Technology	30.3 per cent	26.0 per cent	$\chi^2_1 = 1.04$, $p > 0.3$
On-campus	24.3 per cent	51.1 per cent	$\chi^2_1 = 34.68$,
Off-campus	75.7 per cent	48.9 per cent	$p < 4 \times 10^{-9}$
Rural and remote status	22.4 per cent	30.1 per cent	$\chi^2_1 = 3.48$, $p > 0.06$

a comparison of the population and respondent groups. The population and respondent groups were both relatively large, independent and random, permitting a chi-square test of homogeneity. There was no significant difference between the respondent and population groups in the characteristics of gender, course of study and 'rural and remote' status. The mode of study was significantly different between the respondent and population groups.

Hours per week in paid employment

The average reported hours per week in paid employment was 33.2 hours. A statistically significant positive correlation ($r = 0.58$) was observed between reported hours per week in paid work and age ($\rho > 0.38$, $p < 0.001$). A statistically significant correlation was observed between hours per week in paid employment and mode of study ($F_1 = 137.87$, $p < 2 \times 10^{-22}$); the mean hours per week in paid employment for on-campus students was 9.8 hours; the mean hours per week in paid employment for off-campus students was 40.7 hours. For comparison to data in the literature, it was found that 71.4% of on-campus respondents had some paid work (non-zero average), and, the mean reported hours per week in paid employment for these students was 13.8 hours per week.

Hours per week spent in study-related activities

The average reported hours per week in lectures/tutorials was 3.4 hours. A statistically significant negative correlation ($r = -0.61$) was observed between reported hours per week in lectures/tutorials and age ($\rho < -0.41$, $p < 0.001$). A statistically significant correlation was observed between reported hours per week in lectures/tutorials and mode of study ($F_1 = 326.51$, $p < 2 \times 10^{-38}$); the mean hours per week in lectures/tutorials for on-campus students was 11.4 hours; the mean hours per week in lectures/tutorials for off-campus students was 0.7 hours. The reported median hours per week in lectures/tutorials for off-campus students was zero, as might be expected. The reported median hours per week in lectures/tutorials for on-campus students was 12 hours.

The average reported hours per week in lab work/practical work was 0.9 hours. A statistically significant correlation was observed between reported hours per week in labs/practicals and mode of study ($F_1 = 57.18$, $p < 5 \times 10^{-12}$); the mean hours per week in labs/practicals for on-campus students was 2.7 hours; the mean hours per week in labs/practicals for off-campus students was 0.4 hours. The reported median hours per week in labs/practicals for off-campus students was zero, as might be expected.

The average reported hours per week spent in private study at home was 15.5 hours, with a median value of 12 hours. This reported value was not correlated to any demographic characteristic.

The average reported hours per week spent on campus other than for classes/tutorials/lab work was 1.9 hours. A statistically significant correlation was observed between reported hours per week on campus outside of classes and mode of study ($F_1 = 100.0$, $p < 5 \times 10^{-18}$); the mean hours per week on campus outside of classes for on-campus students was 7.0 hours; the mean hours per week on campus outside of classes for off-campus students was 0.4 hours. The reported median hours per week on campus outside of classes for off-campus students was zero, as might be expected.

DISCUSSION

Response rate and demographic information

The good match between the gender, course of study and rural and remote status demographic characteristics of the respondent sample and population groups suggests that valid conclusions about the population group can be inferred from the respondent group. It is noted that the study mode proportions of the population and respondent groups were significantly different—while the population group contained approximately equal numbers of on- and off-campus

students, off-campus students responded at more than three times the rate of on-campus students. The influence of study mode, and/or any other demographic characteristic, on student responses has been noted.

A statistically significant correlation was observed between age of respondent and mode of study ($F_1 = 102.47$, $p < 3 \times 10^{-18}$); the mean age of on-campus students was 20.7 years; the mean age of off-campus students was 33.6 years. This result was expected, and consistent with previous surveys of Deakin University engineering and technology students [29, 30], as many off-campus students are also mature-age students who have elected to study in the off-campus mode so as to be able to combine their work, study, family and/or other commitments. From this result it is expected that, where a statistically significant correlation between a particular student response and mode of study is observed, it is likely that a similar correlation would also be observed between that student response and age of respondent.

Hours per week in paid employment

The mean value of 40 hours per week for off-campus students is probably related to the nominal full-time working week of 40 hours. The reported median hours per week in employment for on-campus students was eight hours, indicating that many on-campus students are working the equivalent of at least one day per week. In 2000, Long and Hayden found that 65.8% of Australian on-campus engineering students had some form of paid employment [24], which compares with 71.4% observed in this sample group. In 2001, McInnis and Hartley found that, of those Australian engineering students with term-time employment, the average hours per week worked was 13.7 hours [25], which compares to 13.8 hours in this sample group. Given other observations in the literature that term-time employment is rising, the results observed in the sample group are consistent with previous findings.

Hours per week spent in study-related activities

As might be expected, off-campus students spend more hours per week in paid employment and on-campus students spend more hours per week on campus, including classes, tutorials and practicals, and between formal classes. Combining the mean reported time spent in lectures/tutorials and lab/practical work, on-campus students reported a mean total contact time per week of 14.1 hours. This is significantly less than the '22 to 30' contact hours per week suggested in Engineers Australia literature promoting tertiary studies in engineering [31]. Adding the mean reported time on campus outside of classes and mean reported time in private study gives a mean total weekly study time for on-campus students of 36.6 hours. This is also less than the '40–50' hours per week of study listed as an 'expectation' in a recent Engineers Australia presentation on accreditation requirements [32]. As these on-campus results are mean values, it suggests that there are many 'full-time on-campus' students completing much less than the suggested on-campus study load.

General

If it is important that off-campus students get an 'on-campus experience', then what type of experience are on-campus students having? Certainly not the model experience envisioned by Engineers Australia. The median total on-campus class contact hours per week was 14 hours, and the median total on-campus study hours per week was 24 hours, both less than half of the upper ranges suggested in published Engineers Australia literature. These figures are not surprising, given that the average Australian 'on-campus' engineering student is working the equivalent of nearly two days per week. If the justification offered by the Engineers Australia for mandatory residential attendance is the requirement for an 'on-campus' experience, then it is time for Engineers Australia to update its understanding of full-time on-campus study. In many cases, it is likely that the practical engineering workplace experience of off-campus students would exceed any that might be gained through mandatory on-campus attendance for laboratory work or residential sessions. Unfortunately, the type and extent of such experience held by off-campus engineering students is not currently known. The school should survey off-campus students to establish the nature and level of engineering workplace experience that they have and explore means for incorporating the workplace experience of all its students into the process of developing and documenting the attainment of the requisite graduate attributes.

The Engineers Australia accreditation process implies that on-campus study is the preferred and, therefore, the benchmark mode of study, with other modes being inferior and needing to demonstrate 'equivalence' to on-campus study, through the imposition of additional requirements beyond those applied to on-campus programmes. This a priori assumption of the pre-eminence of the on-campus mode of study masks an assumption that what is familiar is therefore the best. In fact, there exists an extensive literature that, regardless of discipline, shows there is no significant difference in student outcomes between on-campus and distance modes of study [33]. It is often claimed that engineering is a 'special case' because of the significant laboratory work component; however, there are many options for off-campus delivery, again demonstrating no significant difference in learning outcomes [34, 35]. Additionally, there are some skills, such group/team work, collaborative design, problem-based learning and leadership that have traditionally required proximal interaction between students—however, there also exists a range of virtual [36] and distance education strategies for these [37–39]. In fact, not only does the literature suggest 'no significant difference' in

outcomes between on- and off-campus education, it is suggested that many traditional forms of on-campus education are not effective learning environments, with the majority of on-campus student learning occurring outside of formal class time [40, 41]. Additionally, it is observed that the boundaries between on- and off-campus study are now significantly blurred, with many on-campus students making use of any available off-campus learning resources to enhance their learning and/or reduce their reliance on attendance at formal classes [25, 40], and developments in distance education leading to transformations in on-campus teaching [42, 43]. The historical dichotomy between on-campus and off-campus students is disappearing, as the two groups become more like each other—sharing work patterns and study resources.

Authors in the UK have identified the equity issues implicit in organisational responses to students' term-time work. There is evidence that full-time students from lower social classes are more likely to do part-time work than those from higher social classes [18]. In the UK, between 1996 and 2001, the amount of paid work undertaken by students from the lowest social classes had increased by 15%, while it had decreased by 9% for students from the highest social classes; in 2002, students from blue-collar and unskilled backgrounds owed in excess of £1000 more than students from professional backgrounds; and students educated in private schools were 23% less likely to work than those educated in state schools [21]. The literature suggests that students of lower socio-economic status are more likely to have to work to support their study, that financial status impacts on a student's choice and mode of study and that term-term work impacts on academic results and/or persistence in study. As the direct costs to students of higher education increase, institutions that ignore the impacts of student work, or dismiss them as 'student problems', are implicitly entrenching class barriers that limit education opportunities for students from lower socio-economic backgrounds and, through their omission, are participating in a passive form of elitism that suggests that higher education, and the lifetime benefits associated with it, are the exclusive right of those that are already privileged.

In engineering education, there is another moral issue that is closely related to student work and opportunity of access to education and relates specifically to off-campus students. In research related to that documented above, Deakin University's engineering students were invited to identify the impact of mandatory residential sessions on their ability to study engineering. The median off-campus response to the impact that the introduction of mandatory two-week residential attendance for each year of full-time study would have on their decision to enrol in their course was 'extreme impact'; 68.7% of off-campus students reported that they would not be able to attend residential sessions (interestingly, more than 20% of on-campus students also reported this); and the principal factors identified by off-campus students as likely to cause difficulty for them in attending a two-week residential session were getting time off work, followed by giving up leave/holidays [44]. There exists a large literature that indicates that off-campus students, including engineering students, drop out at a greater rate than on-campus students (due to work, family and financial commitments) but that those off-campus students that persist do just as well, if not better, in academic assessment tasks than their on-campus counterparts [45] and would make excellent members of the engineering profession. Engineers Australia's insistence that off-campus students, in addition to existing requirements for periodic attendance for course laboratory work sessions, also attend mandatory two-week residential sessions for each full-time year of study for some ill-defined 'on-campus experience' may mean that many otherwise qualified candidates will be denied membership of the professional sphere of the engineering workforce. In times of declining student interest in science and technology, and especially engineering, one could question the wisdom as well as the morality of such arbitrary hurdles for students aspiring to upgrade their qualifications.

CONCLUSIONS

The 'on-campus experience' is not what it used to be, especially when compared to the time when most of the current institutional (education and professional) administrators might have completed their undergraduate studies. The majority of 'full-time on-campus' undergraduate students undertake some paid employment during term-time, and this work is a necessity to support their university studies. It was found that 71.4% of on-campus engineering students at Deakin University reported term-time work, and the average hours per week worked was 13.8 hours. Many working full-time students report that their employment impacts on their attendance at classes. Deakin University engineering students reported mean weekly on-campus attendance hours and mean weekly total study hours significantly less than the 'ideal' hours published by Engineers Australia, the undergraduate course accrediting body in Australia. The on-campus experience has impacts for off-campus students as well. Internationally, accreditation of off-campus engineering study remains problematic and, in Australia, course accreditation requires that off-campus students attend for a minimum mandatory on-campus period. The implication is that on-campus study is the 'gold standard' and other modes of study must, at least in some small way, emulate that standard, even though some of the lustre of the

on-campus experience has been lost over the last two decades.

The modern study-plus-work arrangement of the typical on-campus student is moving closer to the work-plus-study pattern of the typical off-campus student. While some negative impacts on academic achievement due to term-time employment are noted, there are potential benefits as well (enhanced skills and employability), but, whether these benefits are realised depends, at least in part, on institutional responses to student employment. Institutions (education and professional) can discourage or, perhaps worse, ignore student work or provide opportunities for students to integrate their work experiences into their studies and capitalise on the contribution that work can make to professional formation. Acknowledging the changes in the on-campus experience may not come easily for engineering course accreditors, for whom 'hours in classes' (the process) are much easier to measure than education outcomes (the product). This is not a call to relax academic standards or make compromises to boost student numbers; it is a call to adapt the system to optimise all student outcomes in the face of inevitable changes in student work and study patterns. With the cost of education rising, the need for student employment (be they on- or off-campus) also seems likely to increase. If engineering education is unable to cater for this development, it risks becoming an even less relevant study option for students than it currently is.

Off-campus study is not an inferior, second-best option for those students, including rural and remote students and mature-age students, who cannot study full time on campus. In engineering, off-campus study is an essential element of access to education for those in remote locations and/or those seeking to upgrade their qualifications whilst employed. As one of the two providers of comprehensive off-campus engineering studies in Australia, as an engineering school that has a history of pioneering innovation in flexible delivery and as a school located within a university that espouses a rhetoric of equity and access to education, the School of Engineering and Technology at Deakin University should play an active role in setting the agenda, leading the debate and participating in the research related to off-campus engineering education in Australia and internationally.

Acknowledgement—The research presented here represents part of the work conducted for the Higher Education Equity Program project entitled 'Impact of Mandatory On-campus Residential Sessions on Rural and Isolated Students Studying Engineering and Technology Courses in Off-Campus Mode' in 2004. The authors would like to acknowledge the funding for that project provided by the Deakin Equity and Equal Opportunity Unit.

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