A typology of the effects of pre-construction delay for large hydropower projects

J. Plummer Braeckman and P. Guthrie, University of Cambridge, England

This article sets out to discuss the contentions that inadequate consideration is given to the costs and adverse effects of extended periods of project preparation (pre-construction) for hydropower projects and that the failure to deliver projects in a timely and efficient manner is wasteful of scarce resources in a developing country. The recommendation is that project staff, developers, government officials and IFIs should be made more aware of the cost of delay so that they could balance the costs and benefits of their actions.

A graphical form of representation of delay has been developed by the authors curve plotted against axes of time (months of activity) and percentage of project completion (divided into planning and construction). Analysis of data from completed projects demonstrated an approximate 1:4 ratio between the planning aspects of the project and the construction. Thus a hydropower project development curve could appear as in Fig. 1 (data adapted from a real project example).

When a project is delayed, its development curve changes. The effective delay is longer than the initial delay as the delay is compounded by further issues which occur during the delay such as studies or permits becoming outdated and the need for them to be repeated or renewed (see Fig. 2).

Using the same graphical format, a significant delay during construction caused by a force majeure such as a flood or a land-slip, or by unexpectedly poor geology, may be represented as in Fig. 3. In cases of construction delay there are clear incentives to accelerate the schedule after the delay, to recover time. These incentives may include contractual penalties, such as liquidated damages and increased interest during construction, or loss of profits. As a result, in contrast to the experience of pre-construction delay, the final delay may be less than the initial (effective) delay.

1. Case studies

The research used semi-structured interviews and reviews of project documents to produce qualitative inductive research using a methodology based on 'grounded theory' case study approach [Strauss and Corbin 1998[1]]. This methodology was particularly appropriate given the lack of previous research in this area [Creswell 2002[2]].

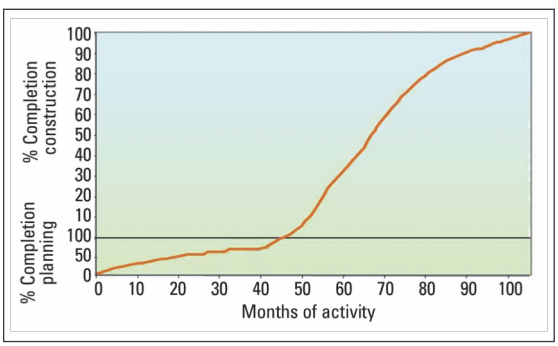

Fig. 1. Typical project on schedule.

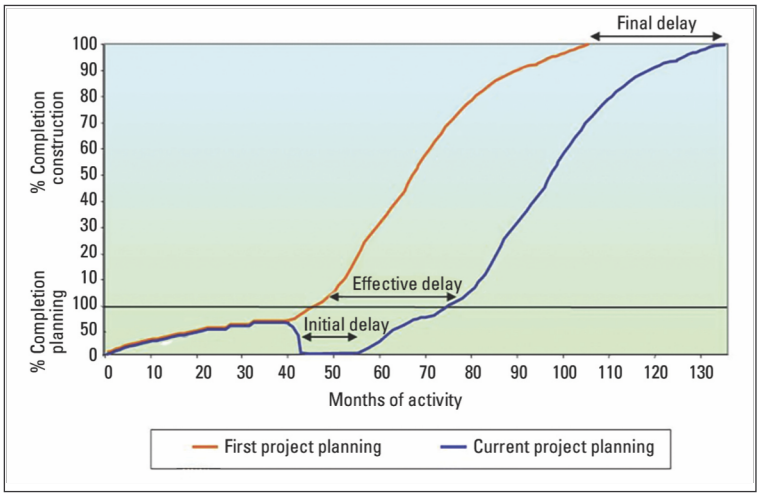

Fig. 2. Project on schedule compared with significant pre-construction delay.

Case study examples were sought in developing country contexts, where the project size was significant compared with the national electricity system or the project investment was large in comparison with the national investment programme; as projects which were 'large' in this sense have the most obvious wider or secondary impacts of delay. Three case studies were selected each of which experienced a significant delay and each of which highlights the various impacts and consequences of delay. The projects analysed were the Bujagali project in Uganda, The Nam Theun 2 project in the Lao People's Democratic Republic (Lao PDR) and the Arun III project in Nepal.

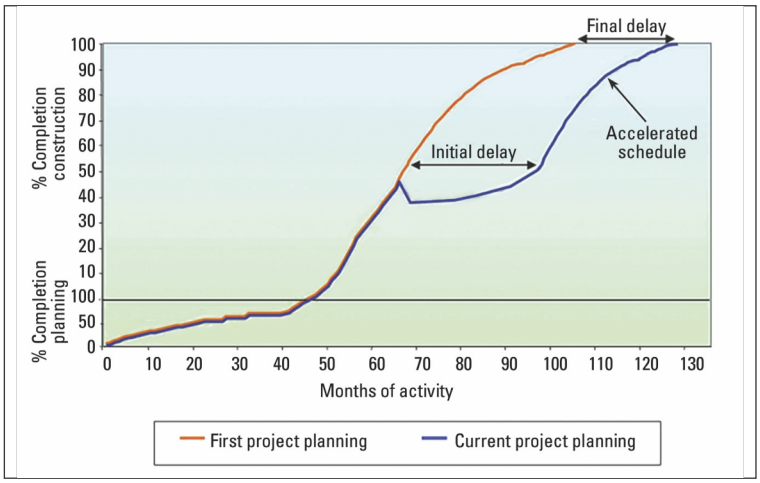

Fig. 3. Project on schedule compared with significant construction delay.

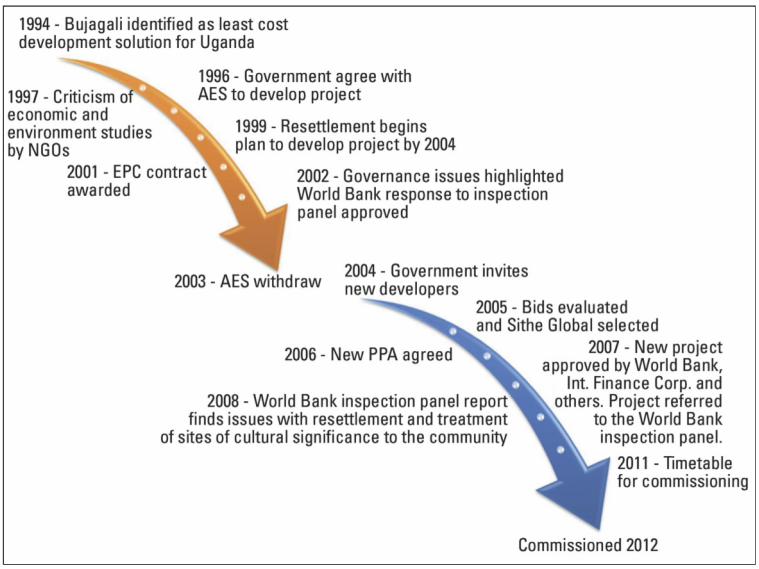

Fig. 4. Timeline for the Bujagali project.

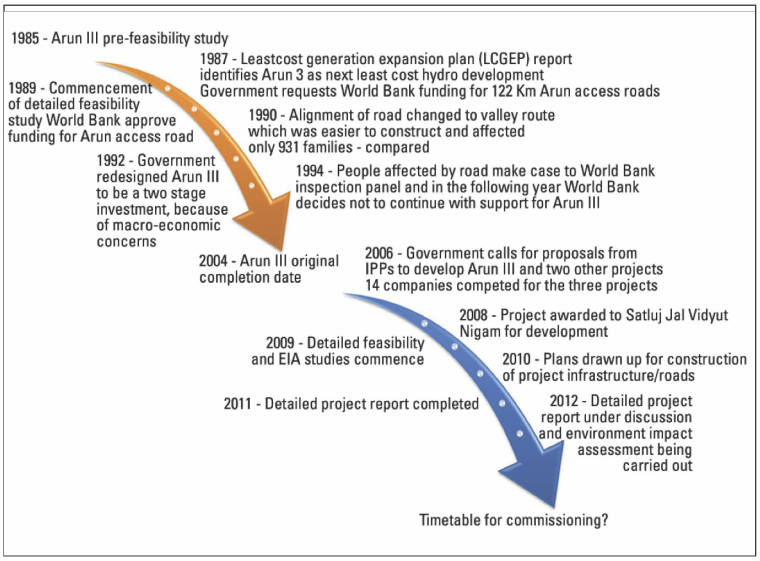

Fig. 5. Timeline for the Arun III project.

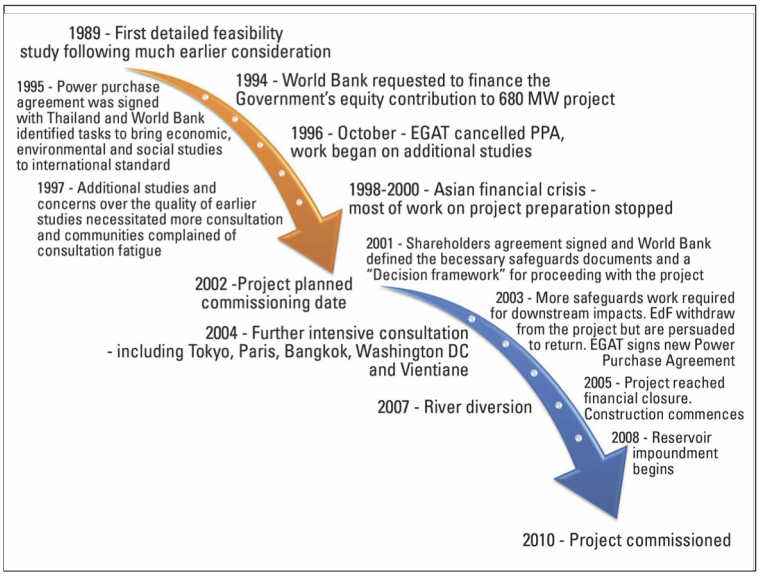

Fig. 6. Timeline for the Nam Theun 2 project.

Construction of the Bujagali hydropower project in Uganda was almost ready to begin in 2003 when, for a variety of reasons, the developer pulled out, abandoning a US$ 75 million investment. It took five years to get the project back to the point of starting construction. During this time, those who had moved as a result of the project lived in 'limbo' between their old lives and their new, relocated but not rehabilitated. Meanwhile, the Government was forced to rely on diesel generation to maintain electricity supplies to the 5 per cent of the population who had access to electricity at that time and also increased withdrawals from Lake Victoria to maintain supply from the existing hydropower plants, in contravention of the riparian agreements for using the Lake. The country lost the expected project development benefit of 6 to 8 per cent of development expenditure for the period of the delay.

The Arun III project in Nepal began preparation in the late 1980s and failed in 1994, just before financial closure, largely because of difficulties over resettlement caused by the access road. Notably, it was the access road that attracted the local population to favour the project, as the area was constrained by a lack of access to markets and there was little investment in the local area. Communities in the project areas lived in uncertainty for more than a decade and remain in uncertainty as, despite a new attempt to develop the project in 2009, construction has still not yet begun. At a national level, the lack of electricity continues to constrain development with winter power cuts in excess of 16 hours a day. The development of this project took such a long time with extended discontinuity of study that the institutional memory of the project has been lost more than once, leading to inefficiency in its development.

The Nam Theun 2 project in Lao PDR was seeking financial closure when the Asian financial crisis hit in 1997 and was at that time expected to be commissioned in 2002. It took a further four years for preparation of the project and was fully commissioned in 2010. During this time the country was deprived of the 3 to 7 per cent of GDP expected to be generated by the project. At the project site the area suffered from significant over-logging during the delay as the area fell between the protection of the developer and the Government. The local communities tired of discussing the project in what seemed to them to be endless consultation with little action.

Using the graphical format presented above and the milestone data from the case studies, the delay was graphically represented as shown in Figs. 4 to 6.

2 Observed impacts

The timelines depicted above show that each of the projects experienced significant delay (and Arun III continues to be delayed) and each experienced different impacts from the delay. The following section summarizes the effects of delay observed in each project with the aim of developing a typology for the impacts of delay.

2.1 Economic Impacts

Time and cost overruns have become synonymous with large infrastructure projects. The financial and economic costs of delays during the planning phase include direct and indirect economic impacts and wasted or idle resources.

2.1.1 Direct economic impacts

Delay affects a project's financial returns in that the revenue streams start later. While it may be considered that a project's life remains 40 years, whether it commences one year or the next, this seriously underestimates the impact on a project's financial performance of late commencement. A project experiencing a two-year delay may produce a net present value in current currency terms that is 46 per cent lower than if it was on schedule (based on a real project economic model and a simple two year delay with no additional cost). Further, if there is any seasonality to revenue streams, such as a significant annual hydrological variation, delay may mean that the project fails to capitalize on a high water season of river flows and begins to generate only in a low water season with consequently lower generation and revenue.

There are also wider economic effects. In constructing an economic analysis of the impact of the project on the national or regional economy, there is the implication that if the project is delayed, then so is the economic benefit, but this is rarely analysed in detail. However, the economic impacts can be greater than the simple loss of economic gain. There may be other impacts. In publicly funded projects, additional costs may divert funds from other essential infrastructure projects further down the pipeline, cascading the delay. Resources may be reserved for a project that then fails to materialize, effectively depriving other projects or sectors of the use of those funds. There may also be costs associated with meeting the shortfall in power supply, such as extending the life of a station which was scheduled for major refurbishment when the new project came on stream, or installing short-term generation options such as diesel-powered units. Worse still, countries may continue with many communities unable to take advantage of electricity supply, affecting their development opportunities and damaging the local economy. In Uganda, the Government was forced to subsidize power from privately installed diesel generation to ensure continued power supply. The direct costs of this intervention and power outages were in the region of US$ 110 million per year of delay, or 1 per cent of GDP. In addition to this, there are secondary impacts such as constraints to investment.

Other direct impacts may include financial losses from changed agreements. The Nam Theun II project had a higher agreed price in its original power purchase agreement in 1997 than in the current version, thus there was a financial loss to Laos directly resulting from the delay, although Thailand received an equal and opposite benefit. Economic costs of lost multi-purpose benefits such as flood control may also be significant. Dams have significant economic multipliers [Bhatia *et al* 2008[3]] giving indirect benefits that are also lost or deferred along with the project.

2.1.2 Unserved energy

The economic and financial analysis of Bujagali established an estimate of 93.92 GWh/year of unserved energy in Uganda in 2005. This estimate is based on power outages to connected consumers and does not include the adverse effect on the development of those as yet unconnected. The cost of this unserved energy is calculated, using a weighted average of domestic and non-domestic demand, as US$ 0.229 /kWh [Power Planning, 2007[4]].

Nepal, suffers from 16 hour a day power cuts in winter, which constrain its development and add additional burden to the industry of using diesel back-up generation. A study by USAID in 2003 estimated the loss to Nepal's industrial sector of power cuts to be US$ 24.7 million a year or 4.43 per cent of industrial sector GDP [USAID 2003[5]]. The extent of power outages has significantly increased since this study was conducted.

Sardar Saravor dam, India (part of the Narmada Basin development)
Opposition by the populace led to a court decision that delayed the dam for five years. During this time, the interest during construction, and lost power generation and irrigation benefits were estimated to exceed US$ 1 billion [World Bank 2003[9]].

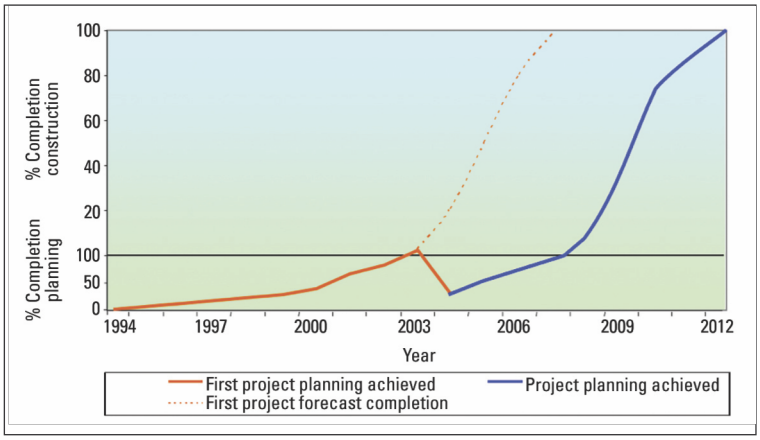

Fig. 7. Bujagali project development curve.

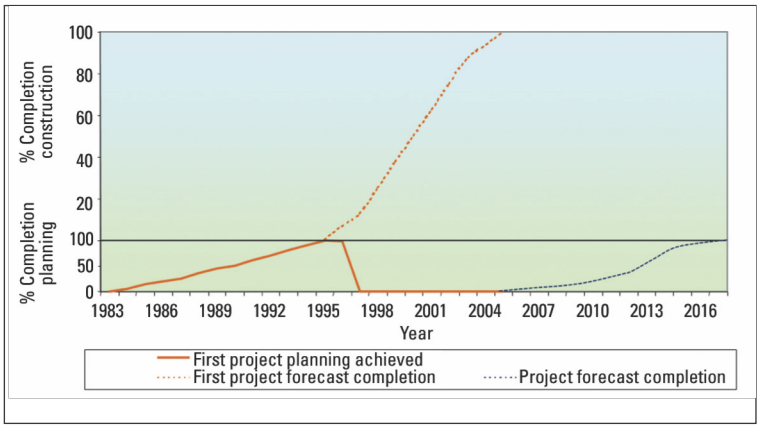

Fig. 8. Arun III project development curve.

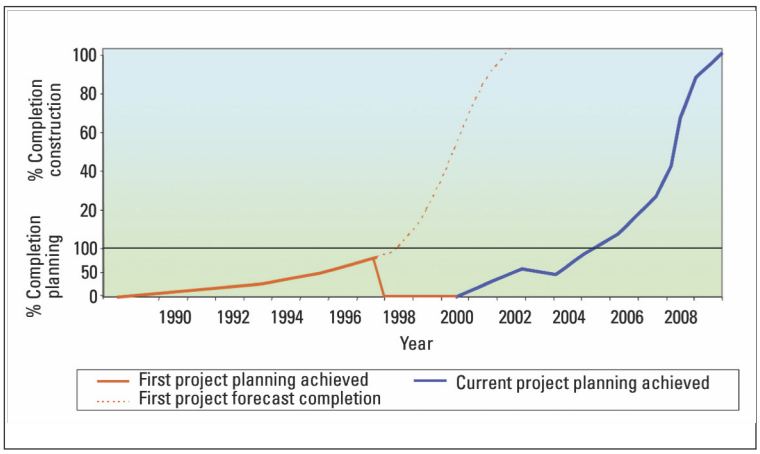

Fig. 9. Nam Theun 2 project development curve.

2.1.3 Local economic impacts

Local villages close to the project site gain local employment and income generating opportunities from a hydropower project. Local people can rent out rooms, or provide taxi or food services and the local market for produce increases. Petty contracts below a certain size are often reserved for those affected by the project and skilled labourers can get work on the project itself. When the project is delayed these benefits fail to materialize. Those resettled for the Bujagali project felt let down that they had moved, partly in expectation of such local economic benefits and the project had failed to materialise [Burnside 2006[6]].

2.1.4 Limits of traditional project analysis

The limitation of traditional project analysis techniques for consideration of delay is made clear by considering the economic rate of return of a project. The World Bank Stakeholder Sourcebook notes that a two-year stakeholder participation process has a relatively minor cost of US$ 9 million, equivalent to the cost of a four-month delay in construction [World Bank 2003[7]]. It thus asserts that a two-year delay to carry out extensive consultation is justified, so long as it saves at least four months of construction delay that might have occurred as a result of stakeholder concerns. It also notes that the impact on the economic rate of return of the project for such a two-year process costing US$ 2 million per year would be only to reduce it from 13.18 per cent to 12.59 per cent. However, such analysis does not reflect the local costs or the delayed benefits.

Even the extent of the economic impact appears to be understated. This can be demonstrated by considering a hypothetical 400 MW hydropower project with a 60 month construction schedule; costing US$ 400 million capital cost and yielding benefits over more than 20 years, giving an economic rate of return of 14.5 per cent. If the schedule for this project is delayed by two years and US$ 4 million is spent in each of these years on additional studies, the economic rate of return of the project reduces to 13.2 per cent, not apparently a very significant drop (although greater than that noted in the previous paragraph). However, the net present value of benefits in the two cases varies from US$ 57 million to US$ 37 million, a 35 per cent fall. If the project cost also increases by 10 per cent, then the net present value of benefits falls to US$ 14 million and economic rate of return of 11.8 per cent (see Table 1), constructed by reflecting delay in a real project economic analysis). This analysis does not include any secondary implications from the delay in power supplies and other benefits.

Thus, when considering the need for further studies or consultation, a simple comparison of the economic rate of return of the project under the two scenarios is not sufficient to give a clear assessment to stakeholders of the economic impacts. When considering an apparently 'small' decrease in the economic rate of return, it is also important to consider the rate of return of the next best project alternative from the least-cost development plan and ensure that the project remains optimal. This is not to suggest that additional consultation or studies should not be carried out, but a recognition that the true cost of doing so may provide incentives to carry out the work without any unnecessary delay.

Table 1: Comparison of economic rate of return of project on schedule and delayed

	Project cost (US$ million)	Net Present Value (US$ million at 12 per cent discount rate)	Economic rate of return (per cent)
Project on schedule	380	57	14.5
Project with two year delay	389	37	13.2
Project with two year delay and 10 per cent increase in cost	427	14	11.8

2.1.5 Waste of resources

The impacts noted above are less severe for countries that can afford to develop more than one project at once. Countries such as China and India may be able to accept a delay on one project as the risk is spread over a large set of projects [Head 2000[8]]. But for many countries, a single project may be all they can realistically pursue, even during the planning phase, as resources for project planning are scarce. If one project is delayed, then it may be very difficult and time-consuming to mobilize funds to commence studies for a 'Plan B' (next best project). Yet least-cost development studies for power planning tend to assume that it is possible to switch seamlessly to plan B in the event of a problem.

One of the criticisms of the Arun project was that it was too large an investment for Nepal. It was suggested that Nepal would be better off developing its small and medium-size hydropower resources. As an experiment in 'switching to Plan B' the difficulties are clear from Nepal's experience. The switch from a single fully prepared project to a large number of small, but unprepared projects, meant that the funds allocated by the international financial institutions for Arun could not easily be reallocated. Indeed, despite the World Bank's promise in 1995 to retain its US$ 175 million commitment to Nepal it took until 2003 [World Bank 2003[9]] to approve a credit for private sector development of small and medium hydropower. This project was restructured in 2008 because of its failure to attract investors and the private hydropower fund reduced from US$ 35.5 million to US$ 9.2 million [World Bank 2008[10]]. Of the five other financiers involved in Arun III, only KfW (German Development Bank) funding was successfully transferred to another power project. It is suggested that even for a medium-size project (50 MW) the time from preparation to commissioning in Nepal is 6 to 10 years [Mahat 2001[11]] making switching a time consuming exercise.

2.1.6 Cost of repetition or update of out-of-date studies

A common feature of long-delayed planning is the necessity to repeat or update studies. In some cases information becomes out of date as technology has developed, or even the hydrology of a river has changed (possibly as a result of upstream developments); social surveys need to be updated and the studies need to comply with whatever new international benchmarks are applicable. This adds significantly to the cost of project preparation, compared with a smooth project preparation plan. The first attempt at Bujagali cost AES $75 million (for the planning and minor infrastructure and resettlement activities which it undertook) in addition to which the Government of Uganda had invested time and resources. There is an argument that the project may be better planned having been studied twice and meeting higher (more recent) standards, but there remains significant dupli-

cation of effort in these studies. World Bank advice to staff on dealing with projects which have legacy issues from the past suggests that project studies (depending on the original quality) will need: minimal review if less than one year old; detailed review and publication with supplementary information if between one and three years old; and, updating and further consultation if between three and five years old. Studies more than five years old should be completely revised and subject to full consultation and disclosure [World Bank 2009[12]].

2.1.7 Linked projects

Projects of the size considered here do not stand alone and must be connected to the national grid, by a major transmission line. Such transmission lines are constructed based on the estimated time of completion of the power station and can thus stand idle if the project is significantly delayed (this is largely an issue of construction delay). In addition, some projects may be associated with the development of a particular industry; for example, hydropower plants are often used to provide power to heavy industry such as an aluminium smelter. If the associated investments proceed, but the powerplant is delayed, then the plant may be unable to operate or earn revenue. Such idle assets are a waste of resources.

2.1.8 Cost increases

For transport projects, each additional year of implementation adds approximately 4.6 per cent, above inflation, to the project cost [Flyvbjerg *et al*. 2004[13]]. In the case studies above, each new project incarnation increased the cost. In some cases this reflects the fact that further study has removed some of the optimism bias from the cost estimates, or there may be true cost increases such as increases in raw material prices. However, there are also indications that delayed projects may appear more risky, and so contractors may add an additional risk premium to their prices. In the case of Bujagali, the project cost doubled. This impact was carefully analysed and found to be a legitimate cost of the increase in raw material prices in the mid 2000s and other factors [World Bank 2007[14]]. A survey of 43 hydropower projects found that respondents recognized that price had increase by more than inflation during a delay [Plummer Braeckman and Guthrie 2015[15]].

2.2 Environmental impacts

Delays to projects can also add additional environmental impacts, possibly even in excess of the adverse impacts expected from the project itself. Environ -mental benefits such as flood control and water conservation may also be lost during the period of the delay.

2.2.1 Lack of environmental protection

In countries where the level of environmental protection provided by the relevant state agencies may be less than ideal, dam sites tend to lose out in the allocation of protection resources. The rationale for this is that the dam site will eventually need to be cleared so there is less of a requirement for protection. There is also an assumption that the project authorities will take care of environmental protection, even if they are not yet in place. Thus when a project is delayed, the area may suffer adverse impacts.

At the Nam Theun 2 project, a member of one of the expert panels for the project noted that the project area suffered from accelerated deforestation (at ten times former levels) until logging was restricted as part of the project environmental management plan [Scudder 2005[16]]. As a result of this over-logging, some of the local forest areas are degraded and the project-affected communities find the additional difficulty of lack of access to forest products on which they previously depended. The project has environmental protection responsibilities with 3500 km^2 of the Nakai Plateau being protected under the project's environmental management plan and control placed on logging in the project site and catchment area [NTPC 2009[17]]. The project brought with it significant environmental protection. Thus the longer the project took to prepare, the longer the area suffered from lack of this environmental protection.

2.2.2 Consequential environmental impacts

There can be significant consequential environmental impacts of project delays depending on what the countries' alternative energy and water sources are. Countries which rely on fossil fuel generation while awaiting a hydropower project may be creating significant unnecessary CO_2 and other emissions. Uganda, while waiting for Bujagali, was dependent largely on diesel generation to meet (or attempt to meet) the growing energy demand. Uganda has 150 MW of privately owned diesel generation and many businesses and private homes use individual diesel generators for personal energy back-up. Estimates (see box) show that Uganda emitted more than a million tonnes of CO_2 during the period 2006 to 2011 by using diesel when it might otherwise have been using power from Bujagali. While this amount is not significant in a global context, it does represent a significant proportion of Uganda's emissions (approximately 28 per cent of the total 2007 according to the Carbon Dioxide Information Analysis Center, and is an underestimate given that it does not account for the private use of diesel generators, which are possibly less efficient and more polluting than large scale diesel generation.

The flows from Lake Victoria into the Victoria Nile which are used for generation at the Nalubaale and Kiira hydropower complex are subject to an 'agreed curve' of abstraction defined by the downstream riparians. This agreement attempts to mimic the natural flow levels such that there is no adverse impact on the downstream riparians and the Lake levels are maintained. There are many factors that affect the lake level, but in 2006 the lake reached its lowest level since 1923 through a combination of regional drought and Uganda's urgent need for electricity, which led to an over-withdrawal of water from Lake Victoria. Water supply infrastructure, docks and fish landings were left high and dry, fish stocks were affected and

Calculation of CO_2 emmissions in Uganda, while waiting for Bujugali	
Diesel generation 2006-2011	4495 GWh
CO_2 emissions per kWh	249 g/kWh
Emissions 2006-2011	1.1×10^6 t CO_2
Note: These figures only reflect large-scale generation and does not include amounts from the use of personal and local diesel generators.	

shallow parts of the lake experienced high concentrations of pollutants. The impacts were felt variously across the three riparian countries of Uganda, Kenya and Tanzania and by the 30 million people who use the lake [World Bank 2008[18]].

Had the Bujagali project been in place according to its original schedule of 2005, the additional power supply could have allowed Uganda to avoid the necessity of overdrawing the water thus avoiding some of the harm to the other riparians.

3.3 Social Impacts

3.3.1 Local impacts of uncertainty

Over the past 20 years, the understanding has significantly improved of the impacts of large infrastructure on the communities directly affected. Analysis now focuses on resettlement and rehabilitation not just in terms of compensation, but also in establishing alternative income streams and sharing benefits. Yet there is little consideration of the impacts of 'waiting' to be resettled, sometimes in excess of ten years. During this time, the affected family cannot sell its house or extend its property (as compensation is fixed on the structure assessed in the social survey) and people's ability to take up alternative employment elsewhere is constrained by the need to establish continued residency to qualify for compensation and benefits. Whole villages start to lose out in the local battle for resources for infrastructure and school provision because it does not make sense for a local authority to invest in a village which is shortly to be inundated; but with project delays the village may live in this resource-constrained situation for years, with consequent damage to health and community relations.

In developed countries, there are schemes to assist areas affected by 'planning blight' including damage to property values that occurs with proximity to proposed major infrastructure projects. These schemes guarantee the householder some proportion of the pre-project value of the property. Generally, in developing countries, no such schemes exist to allow a project-affected family to extricate itself from a project area while still ensuring that it receives the proposed resettlement and rehabilitation benefits. Once resettlement is suggested and the baseline survey is established, villagers no longer have any incentive to invest in their property or maintain the village infrastructure. The World Commission on Dams particularly notes the impact on villages as soon as a project site is identified when a form of 'planning blight' descends on the area with governments, businesses, farmers and others reluctant to make any investment in the area. As a result, the report notes that communities can "live for decades starved of development and welfare investments". The report goes on to express concern about the fear experienced by those living in designated dam sites for extended periods. The impacts of such stress are difficult to quantify but none-the-less real for the affected families [WCD 2000[19]]. Conversely, there are areas where the price of land increases once a project is notified, as there is speculation that the compensation for land will be significantly higher than its agricultural value. This can lead to speculation in land and may result in villagers receiving a price from a speculator much lower than their expected compensation.

Social disarticulation or the breaking down of societal and community structures as a consequence of involuntary resettlement, is a risk in all resettlement programmes [Cernea 2004[20]]. However, it is apparent that this process of social disarticulation begins even before the resettlement actually begins, with the impacts the villages begin to experience once an area is designated for development. Campaigning against a project can give a village a common focus, but it can also change the social equilibrium.

3.3.2 Local impacts of reduced services

Communities in project development areas tend to lose access to public services and assistance as it is assumed that in some way the project is taking care of them. Thus communities can fall between the local Government and the developer (who is not yet on site owing to the delay). The National Association of Professional Environmentalists noted in its press release on AES withdrawal that the communities in the Bujagali Falls scheme area have been 'in limbo for years' because of the project and that it was time more help was given to the communities [NAPE 2003[21]]. The delays to Nam Theun's implementation were considered to be a direct cause of the impoverishment of the people of the area [Scudder 2005[16]].

3.3.3 Absence of infrastructure gains

Hydropower projects often bring with them local infrastructure benefits such as roads and bridges. These can benefit the surrounding villagers who have improved access to markets. It can also open access to newcomers and imported products into villages that have previously lived in isolation, bringing competition into local markets, which the local residents may not appreciate. *Vidyut* magazine, published in Nepal, quotes a conversation between World Bank Vice President Joseph Woods and a Sherpa from the Chepuwa Village near the Chinese border concerning his expectations from the Arun III project. Asked for his views, the Sherpa is reported to have said, "Well, sir, once the road is built up to Num, then we need not carry our annual bag of salt for seven days from Hile" [Spotlight 2004[22]]. Indeed, many villagers cited the access road rather than the hydropower project as their biggest reason for supporting the project. Although some road development has taken place in the past decade, the road has not reached Chepuwa and the villagers still need to walk for many days to buy salt.

3.3.4 Encroachment and changes to baseline survey

Some dam sites suffer from encroachment by people moving into the area in the hope of obtaining compensation for resettlement. During the delay to the Bujagali project, the site was protected from encroachment by fencing and watch patrols, and no significant encroachment took place [Burnside 2006[6]]. However, many prospective dam sites are not so well protected and encroachment by those seeking a share in the expected compensation is not uncommon, particularly when project timelines are extended. To try to avoid encroachers, social surveys are often carried out early in the project's planning process. However, when a delay is encountered there are calls for the social survey to be updated, to take account, for example, of any increases in household size. The process of reassessment reopens the question of encroachers who may indeed have been living on the site for some years and yet are regarded as interlopers by the original local community.

As is pointed out in the thematic review on resettlement prepared for the WCD, "any delay between a survey of 'households' and project development, or evacuation or compensation, runs the risk that those affected will be different from those surveyed" [Adams 2000[23]]. As time passes, households change through births, marriages, deaths or other family events, so the composition of the household originally surveyed may be very different from that currently in place.

The WCD guideline on the conduct of baseline social surveys notes that the assessment of affected households should be updated if the time between the conduct of the original detailed baseline and the project's actual implementation is extended. It suggests that the baseline is updated at the tender stage (although significant delays can occur even after tender), but does not give any guidance on how to deal with the question of encroachment.

One documented consequence of project site designation is that the communities cease to invest in their property as soon as development is anticipated. If the baseline survey is carried out much later than this point, or is substantially delayed, the assets of the community may be valued lower by the assessor as they have fallen into disrepair. This second-order effect on affected communities was noted in the lessons learned from NT2 [World Bank 2006[24]].

3.3.5 Partial or incomplete resettlement

In some cases, the delay occurs once the resettlement process has already begun. This can leave affected families, caught between their old lives and their new lives and without promised support in the difficult adjustments to a new resettlement site. At Bujagali, AES carried out a resettlement programme, which offered (according to Ugandan law) either a replacement house or cash compensation. Many of the affected families opted for cash rather than a house (51 of the 85 families who lost houses) and despite training by AES on managing money and developing livelihoods; much of the money was spent on non-productive uses rather than being invested in assets to improve livelihoods. Those who did opt for a house are reasonably satisfied with the housing and pleased to have formal title to the property, but the promised infrastructure facilities such as a school for the resettled community, fishing piers and protected water sources, were not completed. The affected families complain that they accepted the compensation in the hope that they would get not just the resettlement package, but also longer-term opportunities such as employment directly or indirectly associated with the dam and improved fishing once the dam was complete. They feel let down by the failure of the project to proceed, "We voluntarily surrendered our lands to the dam… while the dam… did not keep its promises" [Burnside 2006[6]].

The World Bank Inspection Panel report [World Bank 2008[18]] notes that the analysis of resettlement impacts for the second project, "did not include an evaluation of the impact of the delay on the socio-economic conditions of the project". The panel was concerned that the livelihoods of the people affected by the project had been adversely affected by the delay and that the families were "essentially left in limbo". The panel findings include the failure to employ a "methodology for restitution of the unintended socio-economic costs incurred by displaced persons resulting from project stoppage/delay".

3.3.6 Impact on the unserved

At a national or regional level, villages awaiting electrification are denied the health, education and development benefits associated with the electricity. Estimates of 'unserved energy' are frequently limited to the restriction of power supplies to those already connected, but the cost to those with no connection can be even greater. These costs are rarely laid at the door of the delayed project.

3.3.7 Consultation fatigue

Another issue with extended times for project preparation is that stakeholders can become weary of the whole consultation process and simply not be able to maintain the interest in continuing to attend meetings or feel that they have to agree to whatever is suggested simply to reach some conclusion to the process. This has been described as 'consultation fatigue' [Diduck and Sinclair 2002[25]]. At the Nam Theun 2 project, *The Economist* records that villagers were becoming frustrated with the consultation process "as the latest delegation passes through, one of the locals wheeled out to meet it complains that he has attended 14 such consultations in the past two years. When, he asks, will his grand visitors make a decision?" [*The Economist* 2003[26]]. This was two years before the decision to start the project was finally taken. Such weariness with the process may lead communities to appear indifferent to the outcome and thus lose out in the bargaining process of setting the resettlement and rehabilitation terms.

3.4 Institutional issues

3.4.1 Institutional memory

Lengthy planning processes can lead to a loss of institutional memory for a project. Staff may move on through a process of regular rotation (as in Government Departments), or retire or shift to projects which look more likely to be successful. Aid agency staff, financiers, consultants, advisers and even community leaders may change. As a result, the memory of the evolution of the project is lost, since documentation of the process is generally poor. Ultimately, when no one can remember why the project took a particular course, there may be need for additional studies, analysis or consultation to revaluate earlier decisions.

3.4.2 Decision making and governance

Public sector employees are increasingly under a microscope of concern for corruption. Their incentives are to avoid any implication that they have favoured another party (particularly a private sector party). As a result they award contracts to the lowest bidder, even if they are concerned that the bidder does not have the capability to carry out a contract to time. In India, the concept of 'vigilance' (anti-corruption) is ever threatening, with careers lost over a minor suggestion of malfeasance. However, vigilance officers are not taught to consider the impact of delay. As a consequence, decisions that cause delay may be taken with impunity despite huge cost implications (see box).

3.4.3 Country reputation

A country may get a reputation for being unable to implement projects on time and this may disincline developers to pick up subsequent projects. Lao PDR for example had many other potential hydropower export projects, but was unable to bring any of them to financial

Table 2: Typology of adverse effects of delay
Local economic and financial
Delayed work and income generating opportunities for local people
Delayed benefits to local businesses
Delay to promised local development impacts such as access to markets (through infrastructure improvements)
Delay to promised local services such as electrification (to support development)
Wider economic and financial
Delayed financial returns to government or state project sponsor
Delayed energy supplies - resulting in additional cost to obtain additional energy supplies
Delayed energy supplies resulting in groups of the population remaining un served (delayed development outcomes)
Delayed energy supplies to industry, particularly where project is intended as a captive plant
Delayed wider economic benefits (e.g. effect on industry or potential investors deterred by lack of secure power supply)
Delayed multi purpose benefits such as water storage, flood control or irrigation
Scarce government funds tied up in the project that could have been used at other projects
Studies had to be repeated at additional cost
Delay to linked projects such as industrial or agricultural development
Project cost increases during the delay (in excess of inflation)
Bidders add a risk premium to project costing as concerned about culture of delay
Delays exacerbated as developer faces cash flow crisis or development spending limits
Local social
Communities live in uncertainty as to the fate of their property or village and so do not invest in or maintain their property
Community social structures break down during extended periods of uncertainty
Government ceases to invest in local services for the village
Loss of positive development impacts such as clinics, schools and other infrastructure
Area is encroached by 'outsiders' leading to community tensions
Resettlement and rehabilitation are partially completed (affected families in limbo between old and new locations)
Consultation fatigue (communities see all talk and no action)
Local people feel that the project has not kept to its side of the (written or unwritten) contract
Delay to implementation of revenue sharing schemes for communities
Wider social
Poor communities remain un-served by electricity with implications for local development and alleviation of poverty
Poor communities lose other development benefits such as irrigation or flood control
Other projects are not started while waiting for a large project to deliver benefits
Local environmental
Lack of local environmental protection - leading to local effects such as de-forestation
Continued use of fuel wood
Petty contractors doing early infrastructure or ancillary works not well regulated
Wider environmental
Continued use of fuel wood due to delay in provision of electricity
Carbon emissions from alternative electricity supplies (typically coal or diesel)
Increased water usage for alternative hydropower supplies in breach of international agreements or common practice
Local institutional
Loss of institutional memory (as staff move away for the project (or are reassigned) during the delay)
No responsibility or understanding of the cost implication for delay so decisions which cause delay are taken with impunity
Wider institutional
Country gains reputation for being unable to deliver projects to time
Bidders discouraged by delayed/repeated processes (reduced competition)
Industrial and commercial investors discouraged by lack of firm power supply

Nathpa Jhakri hydropower project, Himachal Pradesh, India

In the construction of the 1500 MW Nathpa Jhakri project in India, the loss of generation during the rainy season because of late commissioning of the plant could result in a loss of income of more than US$1 million a day. Yet staff agonized over small payments necessary to accelerate construction and avoid delay, and delegated decisions upwards (increasing delay) to avoid accusations that they had made such payments to the contractor for some personal gain rather than to accelerate the project.

closure while NT2 remained in abeyance. NT2 was simply too high profile, but since 2005 when NT2 reached closure, Laos has advanced several other projects. Similarly, Nepal has had difficulty in bringing export projects to fruition, partly because of national security concerns, but also because long outstanding projects like Arun III and West Seti give the impression that the country must be a difficult one in which to operate.

Similarly, it seems that the number of bidders for any particular hydropower project's contracts may be affected by the perception of delay associated with the country's projects. As was noted in the Barker Review of Land Use Planning in the UK, fewer bidders bid for infrastructure contracts where delays are likely and this tends to be only the largest firms who have the financial strength to cope with expensive preparation processes and long delays [Barker 2006[27]]. Nepal, for example, bid out three major projects at one time (Arun III, Upper Karnali and Budi Gandaki) and the latter received no bids. In an industry survey of barriers to hydropower development in Nepal, one respondent said "there is possibly a psychological barrier: when the World Bank pulled out of Arun III this created a loss of confidence in the sector. If a major development bank could not resolve the issues surrounding hydropower development, no one could" [BPI 2009[28]].

3.5 Summary

The typology given in Table 2 characterizes the effects based on the following four main categories of economic and financial, environmental, social, and institutional aspects. Within each of these categories, the effects are divided between local effects that are largely focused on the project area and its surroundings and wider impacts that have an impact on the country or region. The list in Table 2 considers the adverse effects of delay. It is possible for there to be some positive effects (benefits) of delay; indeed sometimes the very cause of delay is the need for further study in one area of the project, which should lead to enhanced outcomes in that area, such as a further environmental study. ◊

Acknowledgement

The authors appreciate the funding variously provided for this research from Engineering and Physical Sciences Research Council (EPSRC) and Newnham College Cambridge.

References

1. **Strauss, A. and Corbin, J., "**Basics of qualitative research: Techniques and procedures for developing grounded theory"; 1998.
2. **Creswell, J.W., "**Research design: qualitative, quantitative, and mixed method approaches"; 2002.
3. **Bhatia, R., Cesti, R., Scatasta, M. and Malik, R.P.S.,** (Eds): "Indirect economic impacts of dams. Case studies from India, Egypt and Brazil", Academic Foundation, India; 2008.

4. **Power Planning,** "Bujagali Economic and Financial Evaluation Study", Final Report and Appendices; 2007.
5. **USAID,** "Economic impact of poor power quality on industry in Nepal", USAID SARI energy program, Nexant; 2003.
6. **Burnside, R.J., "**Assessment of past resettlement activities and action plan prepared for Bujagali Energy Limited"; December 2006.
7. **World Bank**, "Stakeholder involvement in options assessment: Promoting dialogue in meeting water and energy needs: A sourcebook," Blok, K., Haas, L. and Davis. R.; July 2003.
8. **Head, C.R.,** "International trends in project financing prepared for The World Commission on Dams", Knight Piesold Limited, UK; 2000.
9 . **World Bank,** Project appraisal document, Nepal power development project; 25 April 2003.
10. **World Bank,** Proposal to restructure power development project, Nepal; 2008.
11. **Mahat, R.S.,** "The Loss of Arun III", Nepal Study Centre University of New Mexico; 2001.
12. **World Bank,** World Bank internal draft of interim guidance to staff on dealing with legacy issues, made available through personal communication; 2009.
13. **Flyvbjerg, B., Holm, M. and Buhl. S.,** "What causes cost overrun in transport infrastructure projects?" *Transport Reviews*; January 2004.
14. **World Bank,** Project Appraisal document for Bujagali project; 2 April 2007.
15. **Plummer Braeckman. J and Guthrie, P.,** "Loss of value: effects of delay on hydropower stakeholders", *Proceedings,* Institution of Civil Engineers, Engineering Sustainability; 2015.
16. **Scudder. T.,** Unpublished Manuscript - The Lesotho Highlands Water Project (2003) and Laos' Nam Theun 2 Dam (2003 with 2005 updating), T. Scudder Emeritus Professor of Anthropology, California Institute of Technology; 2005.
17. **NTPC,** Nam Theun II Power Company (Project website www.namtheun2.com).
18. **World Bank,** Report of the World Bank inspection panel on the Bujagali project; 2008.
19. **WCD,** "Dams and development. A new framework for decision-making", The report of the World Commission on Dams; November 2000.
20. **Cernea, M.,** "Social impacts and social risks in hydropower programs: Pre-emptive planning and counter-risk measures", United Nations Symposium on Hydropower and Sustainable Development Beijing, China; October 2004.
21. **NAPE,** National Association of Professional Environmentalists, Statement on Bujagali; 2003.
22. **Spotlight,** Cover story of weekly magazine from *Nepal News*, Vol. 27, No. 11; 2004.
23. **Adams, W.,** "The social impact of large dams: equity and distributional issues thematic review I.1", Prepared for the World Commission on Dams; November 2000.
24. **World Bank,** Lessons learned from Nam Theun II, various internal drafts from personal communication awaiting publication; 2006.
25. **Diduck, A. and Sinclair, J., "**Public involvement in environmental assessment: The case of the non-participant", University of Manitoba, *Journal of Environmental Management*, Vol. 29, No. 4; 2002.
26. **The Economist,** "A controversial dam project in Laos", from *The Economist* print edition; 27 November 2003.
27. **Barker, K., "**Barker review of land use planning", Final report recommendations, HM Treasury; December 2006.
28. **BPI,** "Nepal removing barriers to hydropower development", British Power International; 2009.

Bibliography

Head, C. R., "Financing of private hydropower projects", World Bank discussion paper; 2000.

Rojas, M, and Aylward, B. "Private sector financing for current and pipeline power projects 1994 to 2000. International trends in project financing", World Commission on Dams; 2000.

World Bank, "Environmental licensing for hydropower projects in Brazil", Contribution to the debate summary report; 2008.

Judith Plummer Braeckman has, for the majority of her career, worked on large infrastructure and engineering projects in developing countries, most recently with the World Bank. She is now at the University of Cambridge where she has been doing research into the optimization of planning and development of large hydropower projects and analysing the effects of risk.

Peter Guthrie is the first Professor in Engineering for Sustainable Development in the UK, having held this post since 2000. His research is focused on the assessment of large scale projects for sustainability, and energy efficiency in buildings, and work has included consideration of mixed developments, mining projects, housing, health, and educational buildings.

University of Cambridge, Department of Engineering, Cambridge, UK.

J. Plummer Braeckman

P. Guthrie