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An intriguing dilemma confronts American private universities in the 1960s. How can they respond to pressures from their surrounding communities without compromising their essential missions, the education of men and women, the reinterpretation of the past, and the development of new knowledge? In the wake of high student excitement during the waning 1950s, most such universities proclaimed or accepted the need for additional local involvement. Now, in the bereaved 1960s, they are having second looks and asking themselves hard questions: How do we know what is good for a community? Will not diversion of faculty energies from scholarship and teaching weaken the excellence of such universities at a time when they are competing for their very lives against public universities? Where will the money come from to support these new activities when even the established ones are getting harder to support?

Of the many ways these hard questions may be approached today, one that has been too little used, it seems to me, is what might be called the engineer's approach. Our nation has a spectacular tradition of technological excellence, and it is time that university technologists drew on that historic excellence for help in building bridges to their communities; bridges that can be economically built and safely maintained; that, like all good bridges, are accessible and beneficial to those on both sides. The engineer's way—involving a passion for performance, a premium on progress, and the ethic of "making it work"—needs now to be put into action to develop workable university-community programs.

By this I mean that the plans for such programs must have three basic elements which we might identify as: (1) a clear recognition that both sides will have to benefit; (2) a knowledge of the needs of the community and other resources are going to be available. Without all three, institutional programs will seldom succeed for long, however well intended they are, and however well organized the university and community people involved may be. Let me take up these three elements from the engineer's point of view and illustrate them with references to a series of community-serving programs at Princeton University.

First, it is essential to have a clear call from some responsible community leader before the university begins to plan action, because without that call, university programs may be merely packaged brainchildren of intellectuals at best academic excuses, at worst patronizing gestures. Nothing could be worse for university-community relations than for a university to tell its neighbors what they need without asking, or in spite of what they, the residents, perceive. Still the most effective response comes when that call evokes strong ideals of public service.

By way of illustration, in the fall of 1965, a newly elected Princeton Township official strongly called on the University to help the local school system by helping some of its disadvantaged students. As the Township's first elected black councilman, James Floyd represented a community virtually unknown to large segments of the University. His call stimulated many faculty, and led directly to the organization of a six-week pilot program, "Summer in Engineering, 1965," staffed by ten volunteer faculty members from the School of Engineering and Applied Sciences, each of whom worked three hours a day for two weeks, plus several undergraduate engineers as counselors, a few high school students as junior counselors—and 18 junior high school black students in three groups of six.

Before our volunteer faculty members first met with the community planning committee, which councilman Floyd had carefully organized, they had anticipated working with college-bound black high school students. Quickly, the committee let us...
know that in their opinion the community's major problem lay elsewhere, in lower grades and with boys who were not achieving up to their potential. Thus, at the start, the University faculty had to adjust to a need different from the one they had anticipated; in responding, they had to learn more about their surrounding community and particularly its educational difficulties. Because the call had originated with a respected community leader, the resulting program had strong, articulate support in the community, the kind of support that is vital when first year zeal gives way to the inevitable "sophomore slump," and when programs may become more controversial. Programs need secure foundations on both banks if they are to bridge the university-community ravines with more than ad hoc structures.

I will come back to that program, but first let me cite two others, each of which began with a call.

There are deep ravines not only between universities and their contiguous communities, but also between nationally-oriented private universities and neighboring locally-oriented public colleges, particularly the new and rapidly growing community colleges—which according to a recent New York Times story, "once scorned in high schools with ash trays" here exploded since 1960 into a major social force that is shaping industrial development, urban services, and personal pride." Early in 1963 Princeton University received a call from a leader in the local county community college, asking for collaboration in encouraging Trenton high school blacks to consider careers in technology for which they could study in one of Mercer County Community College's many two-year courses. The University responded positively and helped organize such an effort.

One result was that Princeton engineering faculty had a chance to hire disadvantaged 'Trenton high school students to do laboratory work and, in the summer of 1960, to work as junior counselors in the Summer in Engineering program mentioned above. This stimulus led, in the spring of 1971, to the building of a second bridge, between Mercer County Community College and Princeton University. This one provided (1) Princeton graduate students with assistantships in teaching at the community college, (2) community college faculty with research assistantships at Princeton during the summer, and (3) a closer working relationship between the graduate students and the faculties of both institutions, a relationship focused on designing for the community college new technical courses in a humanistic context. That is, studying public works not merely as engineering projects but also in their relation to political and social and cultural values.

Again, without an original call from the community college and a clear articulation of its concerns, the University's action would probably either have been based on misunderstanding or splintered into the personal actions of a few individuals. Instead, the program, funded in part for five years by the National Endowment for the Humanities, has now the strong backing of the chairmen of the parallel departments in each institution, is slowly becoming part of the longer-range perspective of closer institutional cooperation, and has brought one private university closer to that national "major social force!": open-enrollment, two-year public education in badly neglected urban settings.

A call from the Mayor of Newark, New Jersey, provided Princeton with still another opportunity for mutually beneficial collaboration.

In the fall of 1970, Kenneth Gibson, then in office barely six months, came to a civil engineering conference at Princeton University and issued a call, surprising for its emotional power and persuasive in its pragmatic sense. A civil engineer himself, the Mayor called bluntly for help both from universities and from engineers:

Now, I'm sure that you aren't all going to run out and become candidates next year. But I would like to have some help! There are very few engineers in the position I am in, and it is very difficult dealing with some detached thinking up there. I wish I had one engineer on city council. One engineer on my council would save Newark at least one million dollars a year, and I am sure that can be said in almost every city in this country. So come on in: the water is fine!

In this case it was our engineering students who responded first, asking that faculty members help them try to answer the Mayor's plea. In the fall of 1971, a group of University faculty and students began working with Newark people designated by the
Mayor for that purpose. As a seminar project, the student engineers traveled to Newark and environs one day a week to study the urban water supply problem and its connection with the Newark Watershed, whose "giving-away" Gibson had fought as a city engineer. By the spring of 1972 numerous University faculty members, having been drawn into Newark's problems, are beginning to answer the central call of the Mayor by defining an educational program in urban engineering to be sustained by an urban research proposal being worked out between Princeton faculty and Newark personnel, both of whom continually reinforce the ideals first articulated in the Mayor's original and responsible call to action.

Now we come to the second element which seems to me essential in a university-community bridge: that it must satisfy needs of, and produce important benefits to, both the community and the university. Bridges planned or built without that element, in this day of financial constraints in universities, will inevitably collapse under the scrutiny of budget-makers, however much good will existed at the outset.

The bridge must have a clearly visible connection with the community's well being and with those essential missions of the university cited in my first paragraph. Let me demonstrate by referring again to the three programs already described.

The Summer in Engineering program continues to work because it has served the University as well as the community, providing teacher training for our engineering students, promoting interest in engineering in local secondary schools, helping to encourage more minority youth to go into technology, and opening up more possibilities for the academic study of public education. Although University faculty began the program and did most of the teaching during the first summer, subsequently undergraduates have done nearly all, as part of a teacher training program leading to certification. The very teaching of technology has reinforced the undergraduates' sense of the importance of their own studies. Thus, as a first university benefit, the program has brought faculty and undergraduates together in planning the use of labs and in developing teaching techniques. It is a rare but marvelous experience for undergraduates and university faculty (outside of schools of education) to share ideas on the art and techniques of teaching.

Summer in Engineering provided another important benefit to the University. Engineering schools need to attract gifted students, and to do this they must make known to high school students the advantages of an engineering education either as the basis for a technical career or as a sound background for any career requiring analytic reasoning (law or business management, for example). Yet, in the high schools, there is almost no one with any engineering experience. Moreover, the customary separation of math-science from manual training-shop has tended to eliminate the building of things—the making of things that work—from high school curricula, except in so-called vocational courses. Thus, students have little opportunity in high school to discover engineering, little exposure to the engineer's way of learning math and science—which, for many students, can be more appealing and hence more efficient than the more abstract new math-science developed to combat Sputnik. Thus Summer in Engineering was a valuable bridge from our side of the chasm.

I had still another value to us. Most educators have been struggling with the problems of minority education from elementary school through the university, and this kind of program, by focusing on blacks with much teaching done by black undergraduates already well into their engineering studies, has potential for opening up
careers in technology for many young minority students.

Fourth and finally, universities are anxious always to teach in the light of current events. The great upsurge in Slavic studies, Afro-American studies, and Urban studies all follow great public issues. Of course universities do not teach current events, rather they give academic—i.e., historical, cultural, and analytical—perspective to public issues. Education today is at large and as controversial an issue as any now facing the United States. Private universities need more contacts with public education to understand it better and contribute more to it.

So at least four significant needs on the part of Princeton and its School of Engineering and Applied Sciences were served to some degree by the Summer in Engineering program.

As for our programs with the local community college, its benefits to us have already been mentioned. Let me emphasize that it has provided part-time employment to help support our graduate students who are in advanced technical education. Moreover, the faculty-to-faculty interaction, essential to the success of programs run jointly between two institutions, has been structured to introduce community college teachers to engineering research while providing University research projects with valuable assistance. Furthermore, it provides us with first-hand contact in higher public education in an urbanized setting: an essential part of our new graduate program in Urban Engineering.

Consider the benefits Princeton has realized from its relationship with Newark. If working with public, open enrollment colleges can help to broaden the outlook of faculty in private universities like Princeton, so can exposure to people in urban settings such as Newark. Specifically it can stimulate them to use their abstract and analytic rigor to develop new knowledge and fresh insight. As the private university needs experience with urban public education, urban engineering programs in universities need a link with urban public works: with systems of water, transport, power, and shelter. Most major urban centers in America are dangerously understaffed in public works personnel trained in modern technology.

None, however, competes with Newark, where, to quote from Mayor Gibson’s 1970 talk again,

One of the reasons that Newark has had the reputation it has for a long number of years revolves around one area alone. That one area is public works and engineering contracts.

We have a public works department in Newark that works without any civil engineers. Consider that in a city the size of Newark.

Newark’s needs were clear, but Princeton had needs, too, which were served by the University’s involving itself in some deep urban troubles. Princeton had already planned a new program in urban engineering for its students. With that program beginning, plans are being made with Newark people to carry on research appropriate to a university’s talents and beneficial to urban life. Beyond research, one university benefit already appears to be a fresh emphasis on careers in municipal public works. In Newark, urban decay is closely related to the missing middle-level technological bureaucracy which operates and maintains cities, and without whose enthusiasm and integrity no amount of new urban money or revised urban laws can help. University engineering students, undergraduate and graduate, need to know about the immense and exciting opportunities in urban engineering careers—even if the immediate monetary rewards do not match those offered by private enterprise. Universities cannot design machines to solve the short-run urban problems, but they can educate men and women who can develop structures to resolve those problems, and they can provide long-range perspectives as well as analytic techniques to back up those who, like Mayor Gibson, must restructure the cities both physically and morally.

It probably goes without saying, but in the interests of clarity let me put this negatively: a proposed university-community program must be analyzed carefully to make certain it violates neither the central missions of the university nor any of its significant administrative guidelines; and also that—however clearly it may be called for, and however potentially valuable it may be to the institution in some ways—it will not interfere with an educational program.

Now, even when a university has a clear call to do something for one of its communities, and even when it can be shown that doing it will support the university’s own educational program and will have none of the negative effects mentioned in the paragraph above, there remains that third hard question: Can we find the required money, facilities, and personnel in this time of tightened budgets?

Too often, well intentioned people plan far into a program before discovering that no so-called “funding agency” will listen to pleas for support of it. High hopes turn to frustration, and much common good will founders on the apparent insensitivity of local institutions unwilling to risk funds for experimental programs. It is relatively easy to expand high ideals and some reasonable-standing methods of operation, but responsible administrations will look very hard at new proposals which require taking scarce resources away from established programs.

Again returning to the Princeton projects: we knew before planning began on Summer in Engineering that a local Episcopal church was developing summer programs for youth and had available funds. Our planning committee made a successful preliminary appeal for some of those funds. We knew also that some teaching laboratory space in the University was free during the summer and that many engineering faculty were in Princeton most of the summer doing research. Thus funds, facilities, and people were available.

As our planning committee proceeded, it looked into more permanent sources of funding—even though extensive local help was volunteered for the first summer. Thus, before the first summer’s program began, we
were at work identifying funds for following summers. Incidentally, that
council eventually committed $12,000
over three years, creating the unusual
situation of a local religious body giv-
ging funds to a university. By the third
year, the local school system was get-
ing support from Title III of the
Elementary and Secondary School Act
of 1965 (project to advance creativity
in education); funds from that source,
paid directly to the school system,
permitted relatively large numbers of
University undergraduates to receive
pay for working in the schools during
the academic year; also, a number of
high school teachers were paid from
these funds to work in University
engineering labs with their pupils dur-
ing the summer segment of the now-
year-round expanded program called
Engineering and Secondary School
Education. Part of the costs are grad-
ually to be absorbed by the school
system itself as it becomes convinced
of the program's value. Meanwhile
the program, having strengthened
Princeton University's program in
teacher education, has entered the
catalogue of the engineering school.
Participating in this program is a ma-

As for the University-Community
College collaboration, we knew
before planning began that the Na-
tional Endowment for the Humanities
wanted both to help community col-
leges and to relate the humanities to
technology. Previously the Endow-
ment had funded a program at Prince-
ton for connecting civil engineering
education more closely with the hu-
mannities, especially art, architecture,
and history, so that we would look at
the cultural, political and social values
implicit in the engineering of public
works. Indeed, it was the Endowment
that funded the conference at which
Mayor Gibbon issued his call.

That call is, in yet, unanswered be-
cause the resources are not in hand,
but we are confident that they will be
when the program structure is suffi-
ciently well designed to assure some
success--because what administrators
of funding agencies ask is just what
research engineers ask of their experi-
ments--that they be so planned that
success is almost assured.

Indeed, central to "the engineer's
approach" to university-community rela-
tionships which I have been describ-
ing is the engineer's definition of
the word "experiment." At Princeton,
"Design of Engineering Experiments" is
a semester course for graduate stu-
dents in engineering, and, throughout
the University, experimenters put
a great premium on the well-tested
problem and the well-designed experi-
ment. Engineers take the view that a
real experiment is so much more costly
than its design that it should be carried
out only after such careful initial plan-
ing that the experiment's results are
costed and predictable. There is a com-
mon confusion about experiments:
people often think that the outcome of
an experimental program needs to
be certain. The hyman has confused
the technical use of the word "experi-
mental" with a common meaning such
as "unthought out." The fact is, if
an experiment does not know pre-

cisely where his experiment is leading,
and usually just what results are ex-
pected, it is almost certain that he will
fail. The analogy between engineering
experiments and social experiments,
while not complete, is nevertheless
impressively suggestive because it forces
program designers to think each opera-
tion through to the outcome and to
raise the most serious difficulties before
planning goes very far.

Given all this emphasis on the cer-
tainty of results, well designed experi-
ments frequently produce surprises--
and these are often the most signifi-
cant results. Still, surprises are very
different from experimental mistakes.

If a concrete bridge is to be securely
built and is to satisfy a need economi-
cally, then the designer must be cer-
tain that the materials have been
carefully tested and the construction
procedure itself designed against fail-
ure. It would be silly to argue against
the extra cost of this control on the
ground that the artist's rendering of
the bridge is so beautiful and the
people's traffic needs are so great that
construction ought to proceed without
waiting for well worked out designs.
The same principles apply to the
building of university-community
bridges, however much those principles
may seem to complicate and even to
compromise the pure ideals of uni-
versity public service.

The first and ancient requirement of
a bridge, after all, is to remain stand-
ing. But the second and modern
imperative is that a standing bridge
must also serve rather than disrupt the
two communities it connects.