

## Critical Path Modeling: University Planning in an Urban Context

*William W. Vasse, Robert D. Wilson and Ralph J. Stephenson*

### *Introduction*

During the past two years the City of Flint, Michigan, frequently has been in the news. A General Motors town with Buick and Chevrolet assembly plants, Fisher Body plants, a GM parts division and a research and manufacturing AC Sparkplug division, in good times some 75 percent of the work force has been employed in the automobile industry or related businesses. In 1981-82 Flint's unemployment rate has reached a high of 24 percent at times. While some automotive workers are being recalled, the effects of secondary unemployment in small businesses, social agencies, and among professional workers are increasing and may well be longer lasting than the primary unemployment in the automobile industry. However, Flint did not need the current recession to alert it to the fact that the City had serious problems: reliance on a single industry, the shift of GM focus away from Flint where the corporation was founded, the loss of population from the City to the suburbs, a central business district in competition with shopping malls and losing badly were early indicators of trouble ahead. In 1970 civic leaders from the public, private, and philanthropic sectors met to give concentrated attention to the future of Flint and especially to its central business district. A major study pointed to a range of possible projects: revitalization of the Flint River in the downtown area, construction of a major hotel and conference facilities, development of a shopping mall concept, provision of cheaper, and more convenient parking, clearance of substandard housing and development of new housing for a wide range of economic levels, establishment of a major tourist attraction related to the automobile industry, construction of a state office building, completion of the I-475 bypass through Flint, relocation of the Flint campus of The University of Michigan to the downtown area. Some of these projects were already underway in one form or another—the construction of I-475 and the channelization of the Flint River by the U.S. Army Corps of Engineers. These projects would need to be modified to fit in with others yet to

be developed. A key project like the UM-Flint campus was already on the drafting board and nearing a construction start, but destined at the time for a site a mile to the east of Flint's CBD. Some plans, like the hotel and new housing, were well advanced in concept but waited upon assurances that some major development would transform the CBD sufficiently to interest private capital and government support. A tourist attraction related to the automobile industry remained a persistent but elusive idea seeking an expression in realizable form.

The complex interaction of projects that finally resulted from the initial studies might be discussed from the points of view of a number of the key actors: the City of Flint's Department of Community Development, the Flint Area Conference, Inc. (an association of civic, business, and philanthropic leaders), the Mayor and City Council of Flint, the C. S. Mott Foundation, which provided both planning funds and substantial construction funds for several projects, the various state and federal agencies involved. We have chosen, however, to look from the perspective of The University of Michigan for a number of reasons:

1. Relocation of the University campus to the CBD was the key to most of the development projects. Major commitments from the City to purchase and clear 40 acres for the campus site, from the C. S. Mott Foundation and local businesses to provide approximately \$8.0 million toward campus development and construction of a multi-purpose university center building, from the State of Michigan to provide \$10.0 million in construction funds for the first classroom-office building, and from The University of Michigan to relate its educational programs to an urban environment—all were instrumental in demonstrating the seriousness of intent to revitalize Flint's CBD through a major, realizable investment made by the public and private sectors working together.
2. The complexity of the riverfront campus development project was such that it touched in some way on the planning and development of every other project in the CBD, making the campus planning a natural focal point for discus-

*Editor's Note.* The cover photograph for this issue shows the University of Michigan, Flint campus in 1983 after completion of the projects outlined in this article.

sing the relationships between the public, private, and civic sectors.

3. The development of the University's campus involved more than the integrative planning of physical facilities. It entailed an extensive effort to relate the University to its community in terms of academic program, cultural events, recreational opportunities, and conference facilities. Once town and gown joined forces in urban renewal, there was an impetus to explore many different avenues of revitalization for both City and University. As a consequence, many firm and lasting bridges were built between all participants in the Flint project: City government, local businesses, major industry, state and federal agencies, organized philanthropy and private donors, and The University of Michigan.

*Planning Through  
Complementary Goals (1972-74)*

The University of Michigan opened its Flint campus in 1956 as a senior college closely associated with the local community college and sharing its campus. Developing a full four-year

undergraduate program in 1965, the Flint college grew slowly to about 3000 headcount by 1970, and the University began planning a campus development that would provide new facilities and enhance the identity of UM-Flint. Seventeen acres of urban renewal land split in three parcels were purchased close to the existing UM-Flint building on the community college campus (see Plate A). Campus and facility planning were underway and a construction start on the first building was scheduled within one year when it became evident to civic leaders that a university campus in Flint's downtown area would provide the needed major project to kick off revitalization of the CBD as well as a prestigious anchor to the area. Under the leadership of the Flint campus' first Chancellor, William E. Moran, the University accepted the 40 acre campus site offered by the City, agreed to delay its campus development plans by two to three years in order to adapt them to the new site, and gained state acceptance of the change. The University profited by gaining a larger and more usable campus site, an opportunity to participate in a major civic project, greater community visibility and support for University activities and academic programs, a strengthened case for

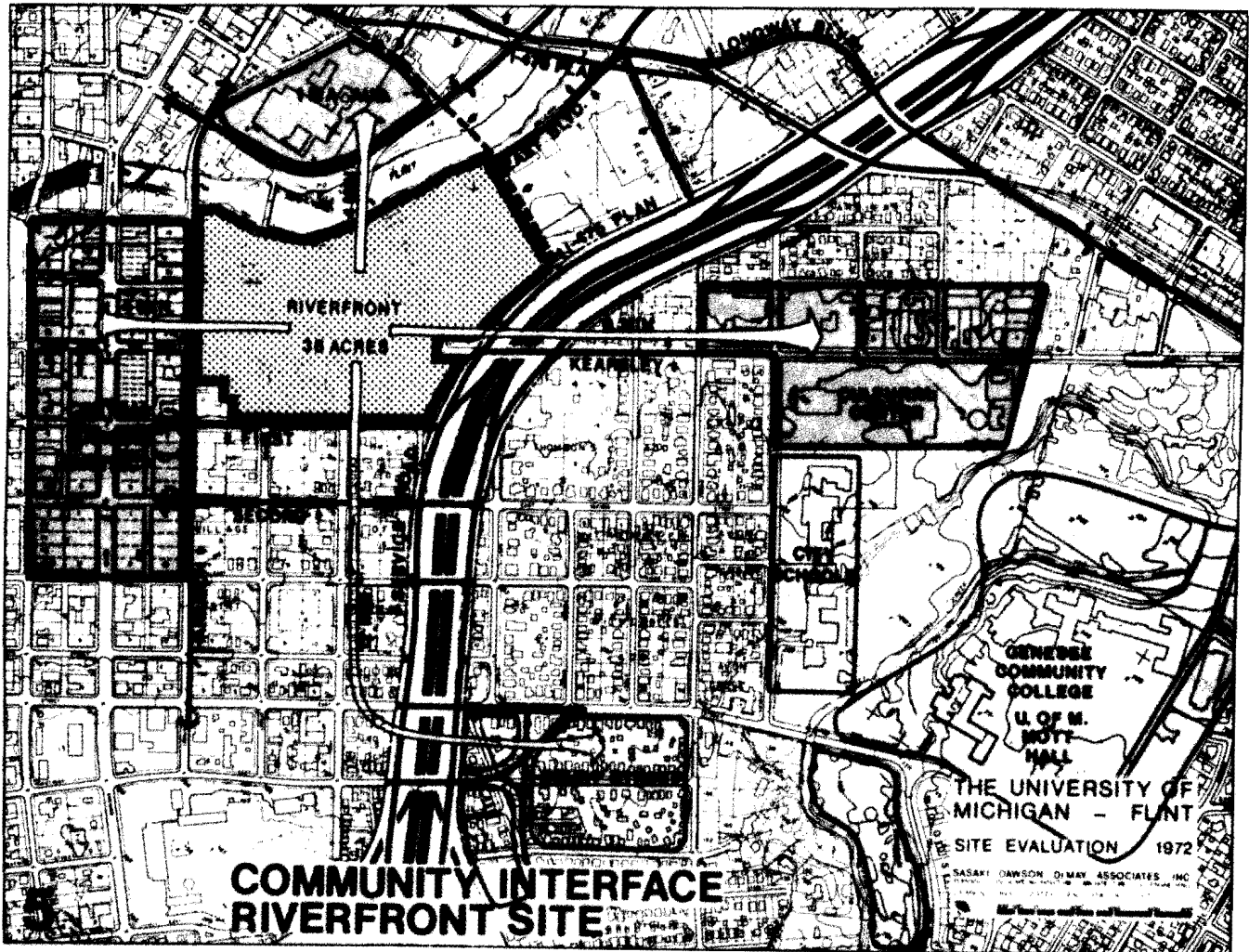


PLATE A

private funds to support campus development, and a heightened institutional identity. It is also true that the University's riverfront campus was perceived by many as seriously disrupting the flow of downtown traffic, and many merchants who had assumed that the University would add dramatically to the economic prosperity of the CBD were disappointed.

Cooperative planning between the University, the City, and the state proceeded on the basis of clearly complementary, although not identical, goals. The first task was to develop a master plan for the riverfront campus. A complex of projects to revitalize the CBD defined the location and limits of the campus, and also provided the major participants in the integrated planning process that was to be developed in the second stage of planning (see Plate A).

1. State Highway Department: I-475 freeway construction borders the campus on the east.
2. U.S. Army Corps of Engineers, City of Flint, community groups: Flint River channelization/beautification project borders the campus on the north.
3. City of Flint, Michigan State Housing Development, C.S. Mott Foundation, Flint Board of Education: River Village housing development to the north of the IMA site.
4. C.S. Mott Foundation, City of Flint, Federal Government, private investors: AutoWorld theme park across the river from the campus on Industrial Mutual Association (IMA) site.
5. CBD projects:
  - a. City of Flint, private investors, civic groups: Hyatt Regency Hotel and convention center
  - b. State of Michigan: state office building
  - c. Private business: Citizens Bank building
  - d. City of Flint, C.S. Mott Foundation, civic groups: planning for downtown shopping mall.
6. International Institute of Flint: construction of a new facility on the southern edge of the campus.
7. University, City of Flint, State Highway Department: development of the Kearsley Corridor east-west link between the CBD and the College and Cultural Center.

The total dollar value of construction, property acquisition, occupant relocation and landscaping will exceed \$300 million when the AutoWorld project is completed in 1984.

Within this context of multiple projects in a very circumscribed area, planning for the University campus took place. The original master plan for as many as 10,000 headcount students was developed by Sasaki, Dawson, Demay under the direction of Robert J. Evans, who had just retired as the architect of the University of California system and wanted to help design an urban campus (see Plate B). Revisions of the master plan were developed by

Johnson, Johnson, and Roy, under the direction of Robert D. Wilson, Assistant to the Chancellor for Campus Planning and Development (see Plate C). The master plan has been used as a guide, neither slavishly followed nor casually deviated from. With each new construction project, physical planners and architects were invited to challenge the master plan concepts, principles, and guidelines. During the ten years of campus development, the validity of the original plan has been demonstrated, and on two significant occasions the plan has been challenged. The architect of the University Center Building, Ulrich Franzen, lacked confidence in the early stages of campus development and felt that the river edge of the campus would never be improved; he proposed to site the building on the Kearsley Corridor. After review and careful analysis, his proposal was rejected, and the building was sited approximately as it had been located in the master plan. However, the science building, which the master plan sited south of the Kearsley Corridor, was relocated north of the corridor in order to continue the concept of interconnecting all of the buildings and to maintain a tightly knit grouping of the buildings that related to each other through all stages of campus development and would always give the feeling of a "completed" campus.

The validity of the campus master plan has been demonstrated as well by its ability to respond to the other projects surrounding the campus, gaining from and giving reinforcement to the adjacent developments. The next few years will tell if even with the best of planning an integrated, attractive, lively and prosperous urban core will develop to enhance the environment of the University's riverfront campus and vindicate that initial judgment to tie the future of UM-Flint to that of Flint's central city.

#### *Planning Through Comprehensive Process (1974-82)*

Once the various elements of the total CBD project were identified, the actors had to be brought into relationship. Critical path modeling and management became the major planning tool to integrate all aspects of the many projects underway in the CBD and those that would enter the stream at a later date. The critical path modeling and management networks became the means:

- of plotting construction starts and time tables to avoid conflict
- of planning utility relocations and traffic patterns to coincide with the needs of construction projects and users
- of defining the responsibilities of various agencies to initiate and complete tasks in a timely manner that would contribute to the total effort
- of identifying and resolving potential conflicts well before their existence could threaten the forward progress of any project
- of pooling the insights and expertise of a

number of professionals from various disciplines concerned with common problems

- of testing alternative solutions to arrive at the one which would be the least disruptive and assure maintenance of maximum progress.

Above all, the critical path modeling and management network became the definitive reference document to record all interactions among projects, and its status as a document exerted considerable control on all parties involved.

Network planning, or critical path modeling and management (CPM), is a familiar graphic shorthand representing an algorithmic method of testing various action sequences proposed for the implementation of a project. Three basic symbols are used: circles or nodes signifying the beginning or end of an action, solid arrows indicating that the action specified goes from here to there, and dotted arrows indicating restraints upon an activity from those preceding it. The three symbols are assembled by the diagrammer into a plan of work based on information provided by those who are responsible for implementing the course of action described in the network—the project managers. Once the network logic is complete, time durations are applied. The network is then calculated using the critical path of algorithm, and Early Starts, Late Starts, Early Fin-

ishes and Late Finishes are determined. In extended application of the system, modeling information is often coupled with other resources such as manpower, money, and equipment by determining job loadings and cash flow. The Flint CPM was developed, diagrammed, and monitored by Ralph J. Stephenson.

Through the early stages of modeling and interaction with the project managers, the concepts and methodologies were evolved for superimposing individual project CPM's upon each other to express an aggregated management picture. What ultimately served as the tool for this management was a system of defining project "corridors" which identified all of the actions that must accrue before an individual project could be completed. These corridor plots for each project resulted in the identification of potential conflicts between projects. As long as there were no conflicts between corridor statements, projects were "go." When corridor statements were in conflict, a problem area was identified and alternative means of unblocking the conflicting corridor statements would be explored. Ultimately the most viable solution, responding to cost and total City/University well-being, would supplant the original corridor statements that had signaled trouble ahead.

An example of two corridor statements in conflict will illustrate the point:

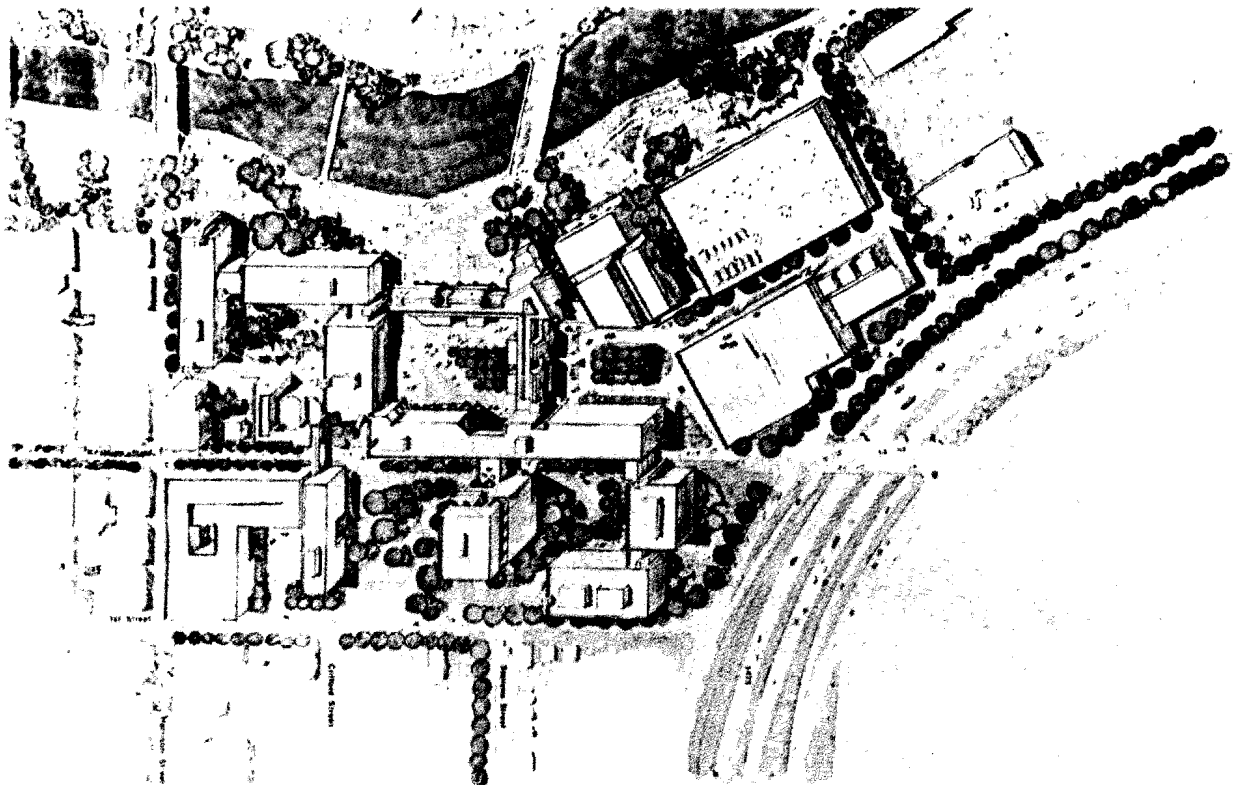


PLATE B

The corridor statement of the University's Center Building construction project included the notation: "Close Stevens Street August 10, 1975, to start project construction." The City Utility Relocation Project clearing utilities from the campus site had a corridor statement that read: "Remove city storm drain from Stevens Street September 1, 1975; complete rerouting of storm drainage November 15, 1975." The two actions planned for the same location were in conflict in terms of time. Once identified, the conflict was resolved by speeding up the City's utility relocation process and by instructing the University's contractor to work around the storm drain line.

The net effect of this very descriptive and visual documentation projected along a multi-year time frame is, of course, a sophisticated combination of management by both exception and objective.

However, the critical path modeling and management process provided much more than tech-

nical analysis of common problems and integrated time tables. It also was instrumental in creating a spirit of responsible cooperation that was one of the most significant aspects of the planning process. Initially most of the project directors took a parochial view, since few had experienced the demands of a situation requiring interactive planning. The University was not a stranger to such a concept, nor was the Corps of Engineers, although the Flint River project was the first in which the Corps had worked with a local city agency providing funding for additions to a basic flood control project. Various city departments were not accustomed to sharing responsibility for complex projects that cut across departmental lines. And entrepreneurial organizations like the Flint Area Conference, Inc., the Chamber of Commerce, the Central City Development Corporation, the Office of the Mayor, representatives of industry and of projects in the private sector had little experience of subordinating individual interests to common goals achievable only through a cooperative process.

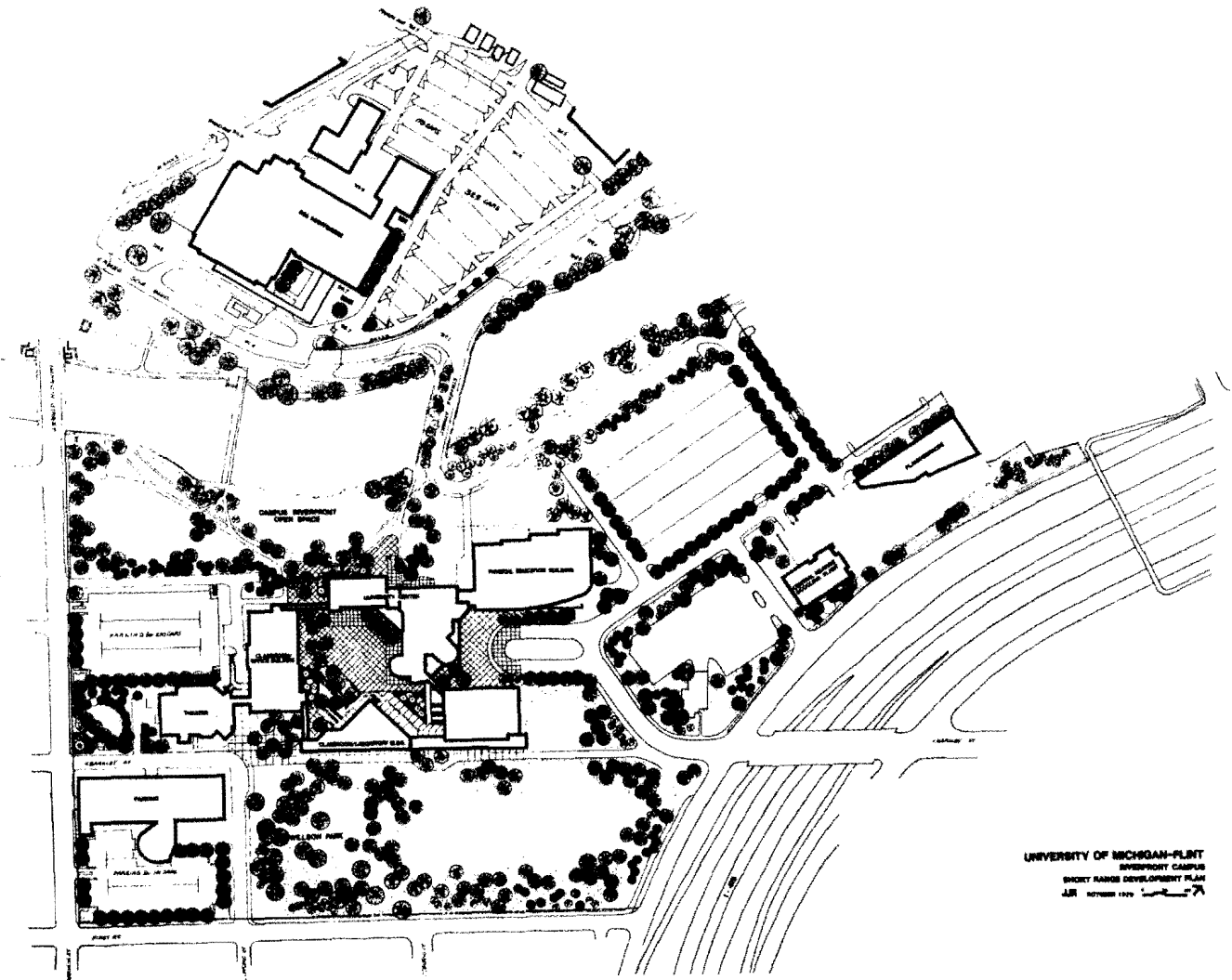


PLATE C

What began as a discordant vying for support of one point of view or project need over another shifted under the discipline of the CPM process from being personality oriented to being goal oriented. Project managers became educated to the total needs of all projects as they worked together. As the managers were forced through construction and review of the CPM to lay out all the problems which projects generated through their necessary interaction each constituency began to accept the responsibility of reasonable give and take that could lead to solutions sensitive to multi-dimensional needs. Further, those participants in the CPM process became advocates to their superiors of the solutions jointly arrived at but possibly perceived by chief executives to infringe upon the sovereignty of their own decision making. Those project managers, especially in the City's Department of Community Development, who had never before guided projects through the construction phase were helped by the CPM to organize and direct their efforts. A high point of the process was a University sponsored seminar for all City division heads to familiarize them with the CPM approach to modeling and management and to help them comprehend their role in project management as distinct from operating a division of city government.

Eventually the CPM began to take on a life of its own, transcending personality, special interest, and particular projects. The discipline of the process created a context within which problems could be defined and analyzed *before* solutions were offered. The evolution of a cooperative planning process made it possible to respond to new concepts and new projects without succumbing to opportunism and to quick-fix solutions. As participants in the CPM developed a long range view, it became possible to look beyond project completion and to combine planning with strategies for operations that would entail cooperation among various agencies. This was particularly successful in planning the operation of the University campus as it interfaced with city services and operation of the River Beautification project as it interfaced with both the City and the University. Finally, it is evident that the cooperative spirit of the CPM process developed a mind-set among the participants that has facilitated cooperative planning and interaction in areas other than construction and physical developments.

A few examples will serve to illustrate the range of issues successfully dealt with through the CPM process.

1. Property acquisition for the 40 acre campus had to be plotted to keep pace with the construction of facilities. Within city government this meant coordination of the legal, real estate, relocation, demolition and community development functions to meet University legal requirements and construction deadlines. Property was conveyed parcel by parcel to the University over almost eight years as it was acquired by the City. While once or twice the timing was close, the Univer-

sity always had clear title to property destined as a building site.

2. Coordinating pedestrian and vehicular traffic in the CBD under intense redevelopment posed a particular problem. The City's traffic division established a master plan for vehicular traffic that would be operational once the total CBD plan was accomplished, but for several years the demands of various projects would force temporary variations of the plan. Most significant was the fact that assembling the 40 contiguous acres of the University campus demanded the closing of a major east-west street and a major north-south street (see Plate A). The east-west street became the main pedestrian corridor of the campus, the Kearsley Corridor, still linking the CBD with the College and Cultural Center east of the campus. The north-south route was one used by Fisher Body trucks to carry auto bodies to the Buick assembly plant, a process requiring careful timing of the carrier runs. Analysis of all possible alternative routes led to the conclusion that until the freeway surface roads could be opened, the north-south traffic would have to flow through the campus, the inconvenience and potential safety hazard being the trade-off for helping Flint's major employer maintain its production schedule. While street and bridge closings and establishment of one-way streets were always well advertised to the public, many long-term Flint residents have yet to come to terms with new patterns of movement in the CBD, and some merchants identify such difficulties as a reason for loss of business.

One interesting case of traffic planning is that of the Stevens Street Bridge over the Flint River (see Plate C). Seemingly rendered useless when the University closed the major north-south artery through the campus and when the traffic by-pass was closed once vehicles could be routed on the freeway surface roads, the bridge was regarded at first by the City as a burden which it wanted either to demolish or to hand over to the University to maintain. Initial analysis through the CPM indicated a continued use for the bridge as a pedestrian route between the campus and the River Village housing project to the north. Subsequent decisions to locate the AutoWorld project on the IMA property across the river from the campus highlighted the potential of the bridge as a crucial link in the traffic circulation pattern. The University agreed to maintain a one-way traffic pattern along part of its river edge property to connect with the bridge. Keeping options open while exploring many possible uses for a seemingly useless bridge avoided precipitous action that would have precluded an effective response to new developments in the total range of projects that had to interact.

3. The CPM provided the context for developing environmental compatibility among various projects. One example was the University's decision

to establish the west edge of the campus, next to the CBD, as the area of highest density and to lower the density toward the east in order to create a transition between the CBD and the residential atmosphere of the College and Cultural Center east of the freeway (see Plate B). Initially the University's decision to locate its major parking facility away from the CBD was regarded as unsupportive of downtown businesses. With actual experience of the habits of student parkers, the location is regarded as a helpful segregation of parkers who are unlikely to contribute much directly to business revenues in the CBD but who would create great parking problems for potential shoppers. Cooperation of the City, University, and Corps of Engineers is seen in the treatment of the river's bank as it moves from the relatively hard-edge of the river beautification features eastward to a more natural and less formal landscaping.

4. Architectural compatibility of major new buildings was arrived at through an awareness of total effect deriving from the CPM process, although no formal decisions on design were made through the process. Nevertheless, compatible brick and glass were chosen for the buildings, harmonious patterns of fenestration were developed, poured concrete columns were established as a repeated design element. Still open to question is the concept of skyway pedestrian connections among all elements of the CBD development. Such connections exist to a limited extent in the downtown area connecting the hotel, a parking ramp, and the new bank building. The campus has skyway connections between its classroom-office building, the University Center, and the recreation building; future building—a library and a science building—will also be connected into the complex by third-floor covered walkways. However, the University has yet to agree to a revision of its master plan that would relocate a future building to the western edge of the campus and make a connection with the CBD practical.
5. Utility relocations required cooperation among users, the City, and the local utility company. Utilities which previously ran through the University campus had to be routed around it and service adapted to the University's needs. The CPM was of particular importance in establishing the timing or relocations so that as little disruption would occur as possible and as many projects as possible might benefit from a single relocation. The CPM helped to resolve issues of essential easements for utilities that could not be relocated economically and to establish the most economical and environmentally acceptable routes for those that had to be changed.
6. Planning for public events figured prominently in the CPM process, since economic life in the CBD did not come to a halt during construction. Rather, an emphasis was placed on parades, street fairs, sidewalk sales, and ethnic festivals

in the downtown area in order to encourage the public to become familiar with the changes taking place in their City and to discover that downtown merchants remained accessible. Each event was scheduled in the CPM network and the conditions defined that could make the event possible: clear traffic patterns; street closings; utilization of facilities. More complex territorial issues were involved in planning public access to the riverfront area, fishing regulations, and public use of the University campus riverbank. The CPM provided a forum for defining usage issues, exploring tolerances for different types and levels of usage, and establishing responsibilities for cooperative security measures.

It is difficult to trace a direct relationship between the CPM with its group of participating professionals and integrated planning efforts encompassing larger community groups. However, it is a premise of this paper that cooperative planning in one sector will create the context for similar efforts in other areas.

One notable example was the Flint River Beautification Project. Civic groups were unwilling to live with the basic flood control project designed by the Corps of Engineers for the stretch of the Flint River running through the CBD. One group, the Flint Environmental Action Team, led a successful fund drive to provide an array of public facilities and water features that would add to the attractiveness and usefulness of the river. The City's Department of Community Development and the landscape architects, Halpern Associates, led a carefully orchestrated and well publicized community workshop to surface suggestions for features desired by the public. If the end result bore considerable resemblance to the landscape architects' designs for the San Antonio riverfront development, there was nevertheless a genuine and positive feeling of public participation in Flint.

The same public involvement was attempted in designing the facilities and services for the River Village housing development, located north of the IMA site, but we failed to achieve a positive consensus. Possibly the problem was too complex to be handled in such a manner, the conflicting agendas of public service professionals and special interest groups too irreconcilable, the stakes too high for the various investors in the project. A planning disfunction in the same area occurred when the University and the City were unable to come to agreement on the inclusion of housing appropriate to student needs in the project.

Throughout the planning of the riverfront campus, the University and the City worked closely with the State Highway Department through the CPM process to develop modifications of already completed plans for the I-475 freeway. In response to the new conditions introduced by the campus, the closing of streets, and new traffic patterns, some modifications were made in off/on ramps and

frontage roads, and bridges were relocated to respond to street closings. The University and the state helped solve each other's problems by the conveyance of several small parcels of property, enabling an effective design of access to the campus from the frontage road. Such cooperation set the stage for a major community effort—again led by the Flint Environmental Action Team—to convince the State Highway Department that its planned sound barriers of precast concrete slab were far from positive contributions to the environment and no cheaper than more aesthetically pleasing solutions. Thanks largely to a history of cooperative problem solving and to the leadership of the University's chief of campus planning in finding a creative solution—plus some local, state, and federal legislative pressure—the State Highway Department accepted a new design featuring piers and walls of a warm earth-tone jumbo masonry.

#### *Planning Through Cooperative Programs (1977-1982)*

The integrative planning process of the CPM set the stage for City/University cooperation in the programmatic usage of facilities that they had planned and developed:

- Town/gown use of the Riverfront Park facilities ranges from fishing contests, to festivals, to concerts.
- Community access to the conference, food, and recreational facilities of the University Center has made it a significant point where City and University meet.
- Community access to the new recreation building provides a positive addition to overcrowded recreational facilities in the downtown area.
- The open space of the University's riverfront campus has been the site of the annual International Festival, of the Flint Bluegrass Festival, and other similar non-University functions attracting large crowds to the central city area.
- The University and the community have joined together in successful arts programming, using both University facilities and those of the College and Cultural Center.
- With the support of local foundation funds, as well as state and federal funding, the University has constructed and operates a public television station that interacts with community groups and has gained significant community support in the two years it has been on the air.

On the whole, it is evident that the University and the community it serves are developing a very positive interdependent relationship that is seldom to be found among publicly supported institutions serving urban areas. Such developments have their origin in cooperative physical planning and are an

extension of the fruitful interaction of the University with many agencies and groups external to it during the early phases of campus development.

#### *Planning Through Congruent Needs (1980-82)*

At the 1972 SCUP conference, William W. Vasse described the academic planning of UM-Flint in a paper titled "Faculties and Change: Academic Planning in the 1970's." Given the resources, it is considerably easier to build buildings than it is to develop major new academic programs that will respond to the needs of an urban area. UM-Flint's academic planning first served to interact usefully with the planning of the riverfront campus, and second to set general guidelines for the development of professional and broad career programs that would speak to the needs of business, government, health care, and other important sectors of the Flint community. All programs were developed in consultation with those sectors of the community most involved and all make use of the community resources for instruction and internship opportunities. Some of the academic programs long in planning and brought on line during the past two years are the following:

1. An MBA program was designed for the part-time student who has spent some years working in the field. The program is intended to be responsive to the need of General Motors and other businesses and corporations to provide promotable employees, especially engineers, with the educational experience that will make it possible for them to move into higher management positions.
2. An MPA program was designed in cooperation with local governments and public agencies. Now the program will expand to include school administrators.
3. Health care programs have been developed in conjunction with local hospitals and other health care facilities. The most successful is a program that accepts certified health care personnel—most of whom will have an associate degree—and provides them with a course of study leading to a baccalaureate degree and preparing them for management positions. Local hospital management executives provide much of the instruction as adjunct faculty, and students intern in a wide range of health care facilities.
4. In response to the UM-Flint mission to prepare baccalaureate degree students for entry-level in various professions, The University of Michigan has relocated its physical therapy program from the Ann Arbor campus to the Flint campus. Local hospitals and foundations have generously underwritten the program with bridging funds of half a million dollars and are supplying instructional resources, clinical facilities, and student housing.
5. A communications program now under development of a college/community relationship



that now extends well beyond the original motives that brought UM-Flint to the CBD and its riverfront campus.

### *Conclusion*

What useful precepts can be drawn from this narrative of ten years of interactive planning and project implementation?

First, the discipline of interactive planning exercises a control that leads in the short-term to effective analysis and resolution of conflicts.

Second, such a planning process can frequently produce better solutions through a group process than are likely to come from professionals who are focusing all their attention on a single project.

Third, a process that creates common goals and common understanding has the capacity to generate a predisposition to cooperative efforts that may transcend the immediate tasks at hand.

Fourth, the very nature of a university—its multi-faceted programs, its on-going and ever changing life, its capacity to relate to a multiplicity of external constituencies, its very visibility in a community—all argue for an effective central role of the university in the interactive planning process of any community, nor need such a process be restricted to planning for physical facilities and their construction.

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