

## *Visualization is one of the critical pillars within Computer Associates' strategy*

By Ken Fitzpatrick  
General Manager, Marketing, Computer Associates International



It is my pleasure to have the opportunity to address the loyal customers and partners of MultiGen-Paradigm. Computer Associates' acquisition of MultiGen-Paradigm demonstrates the importance of realtime 3D technology to fulfilling the promise of 3D visualization. Our vision is broad, encompassing the use and deployment of 3D visualization. The applications developed within entertainment, commercial & defense simulation, and urban simulation represent the most important areas of the market for 3D visualization today. Our senior leadership within CA is excited

about the potential of the technology and committed to the simulation and training community.

To demonstrate this commitment, MultiGen-Paradigm will be releasing updated versions of MultiGen Creator, Vega, and the Sensor product line in September timeframe. These product releases demonstrate that MultiGen-Paradigm will continue the time-honored tradition of releasing quality products in a timely fashion. Our commitment spans beyond meeting product timelines. The senior management team within CA, comprised in part of MultiGen-Paradigm executives, authorized an increase in visualization engineering staff by over 25%. This staffing will be used to improve the delivery process on key projects with the US Air Force, US Army and other related service programs. We fully expect that the technology developed in these programs will be infused back into the mainline products (MultiGen Creator, Vega, Sensors and future MultiGen-Paradigm products).

Visualization is one of the critical pillars within Computer Associates strategy. Advancing the state of realtime 3D technology and 3D visualization in general will play a

critical role in the execution of our company strategy. For instance, we remain very optimistic regarding the integration of visualization with Neugents (software that can think). The most compelling future applications will be based on a combination of Neugents and visualization technology from MultiGen-Paradigm. The integration of these applications with database technology, like Jasmine *ii*, will create a renaissance age for the development of usable training, simulation and business related applications.

Information is complex, dynamic and multidimensional – visualization is the simplest yet most powerful way to communicate complex information. CA and MultiGen-Paradigm have the technology and smart, talented people who will continue to provide unique solutions to address core visualization needs now and in the future. We are proud to be working with each of you on building the architecture for 3D visualization for the future.

# Accelerating the pace of innovation for visual simulation and 3D technology



In the last issue of TakeFlight, we announced the acquisition of our company by Computer Associates and committed to you that we will remain dedicated to the success of the visual simulation community.

MultiGen-Paradigm remains committed to our core markets and we will continue to develop next-generation 3D products and services for aerospace and defense industries, entertainment, and urban simulation. And we will further advance the capabilities of CA's leading edge products and technologies including Unicenter TNG, Jasmine *ii* and Neugents. Through 3D visualization, CA clients can provide differentiating value in their eBusiness applications, improve the productivity of their employees and partners, and develop compelling solutions giving them a competitive edge on the Web.

Our team has made positive progress in several areas. First, we are releasing new versions of MultiGen Creator, Vega and our Sensor products. Second, at SIGGRAPH, we demonstrated 3D scene visualization using two OpenFlight databases. This demonstration allows the user complete control over the database and provides amazing level of fidelity all running on a low bandwidth Internet connection. Finally, we continue to make positive progress on the US Air Force, Navy, and Army service programs. You can view our latest technology at any of the upcoming tradeshow including AUSA (October) and I/ITSEC (November).

The Computer Associate acquisition has brought up many questions from our partners and customers. We, within MultiGen-Paradigm, view our association with CA positively as we aggressively chart the future of visualization. One constant theme, our valued customers and partners will continue to receive—from our sales team to product development to customer support staff—unparalleled services and the highest standards of quality. We look forward to working with you and the best partners in the world on accelerating the pace of innovation within all aspects of visualization technology.

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## CALENDAR

Now through the end of 2000, MultiGen-Paradigm can be found at the following tradeshow:

- 2000 Fall Simulation Interoperability Workshop (SISO), Orlando, Sept 18-21  
Booth 14
- AUSA Annual Meeting, Washington DC, Oct 16-18  
Booth 624
- I/ITSEC, Orlando, Nov. 27-30  
Booth 640

If you're attending any of the upcoming tradeshow, drop by for demonstrations or simply stop by to say hello!

# What's New

## MultiGen Creator 2.4

By Todd Griffith  
Product Manager, MultiGen Creator

- Multi-texturing: Now apply up to eight textures per face for single-pass or multi-pass rendering
- MultiGen Creator now saves the desktop layout of your favorite tool palettes and windows between modeling sessions
- MultiGen Creator now preserves node names when copying and pasting either within or across separate models
- Revised and improved light point and light string editing tools to more easily generate air traffic lights is in Creator Pro
- The new terrain project tab and file (.prj) in Terrain Pro manages all of your preferences and coordinates your work
- Terrain Pro now has irregular mesh, a new terrain-generation algorithm that combines the efficiency of a regular polymesh and the accuracy of Delauney
- With irregular mesh, you can generate terrain files containing t-mesh nodes, which can facilitate faster load times and rendering speed—fine tune your realtime engine for high performance
- The realtime standard format, OpenFlight, is revised to version 15.7 to support multi-texturing and the new t-mesh node
- Broader support for file formats in the MultiGen Creator
- architecture, including 3D Studio R4 (.3ds) and stereo lithography (.stl) on both platforms
- MultiGen Creator now has a plug-in to view models in a sample realtime viewer! The Vega Viewer is a “thin” runtime version of Vega, the award-winning realtime development engine
- Sub-divide v2.0 is a plug-in developed for MultiGen Creator that now contains a bevel tool for more rapid and efficient organic modeling
- Plug-in Architecture Support—more than a full year’s worth of Plug-ins of the Month are now available on the MultiGen-Paradigm website
- Improved on-line help, and new modeling and terrain generation guides for the beginner and the expert
- MultiGen Creator now also supports Microsoft Windows® 2000 Professional

## Vega 3.5

By Christian Cole  
Product Manager, Vega

- Distributed Vega for synchronized displays across multiple NT systems
  - Virtual Texture (NT) supports extremely large database imagery.
  - Streaming audio feature eliminates the need to allocate large amounts of memory when dealing with large audio files.
  - Microsoft Windows® 2000 Professional support
  - Detail Texture Support is now available through the OpenFlight Loader and at run-time for files that use OpenGL detail textures.
  - Exposed API for Sensor Products Utility Library
  - SensorVision compatibility with Marine and NSL now makes it possible for marine effects and navigation lighting to be rendered in infrared
  - NVG effects
  - SensorWorks and RadarWorks on NT
  - Supported installation of vgTcl means applications can be assembled at run-time of small interactive scripts, with capabilities added as needed.
  - Coming soon, support for Linux
- These are just a few of the new features in MultiGen Creator 2.4 and Vega 3.5. Ask your rep for more details about these and the many other new features.

## Urban Simulation Market Update

Hello to everyone! I am pleased to report that the Urban Simulation market is alive and well. The demand for using realtime 3D visualization for urban planning, architecture and engineering applications is growing at an increasingly rapid pace. Now, as a part of Computer Associates, MultiGen-Paradigm's 3D solutions have expanded significantly into new areas.

**Computer Associates** - Let me first talk about what the Computer Associates acquisition means for Urban Simulation. As you have already read in this issue of Take Flight, MultiGen-Paradigm, Computer Associates' visualization experts, will, in addition to providing world class realtime 3D products and services, deliver new and innovative visualization solutions. Specifically, we are very excited about what Computer Associates' facilities management and e-commerce solutions offer to the urban simulation and AEC (Architectural, Engineering and Construction) industries.

**Facilities management:** Many of you may get involved directly with, or participate in the planning of building management systems. The ability to efficiently manage and monitor all the critical operating systems within a building can be a daunting task for building and facilities managers. Computer Associates' Unicenter TNG (<http://www.cai.com/unicenter/>) is currently being used in an exciting

application that displays and monitors critical building systems in *realtime* and in *3D*! In June, we were able to demonstrate this application to AEC Systems 2000 and it was quite impressive. Unicenter, connected live to a server in the United Kingdom, was able to monitor the heating systems, computer networks and security systems at CA's European Headquarters building in England. If, for example a network server was reporting problems, the application "flew" through a 3D model of the building to exactly where that particular server was. From there, we were able to query the system further for up to the minute status reports on the problem.

**E-commerce:** This phrase gets quite a bit of visibility these days. For the AEC industries, using the web to preview, for example, building materials or furniture during the planning stages of a project can save a tremendous amount of time. Computer Associates' Metastream 3D streaming technology can deliver products on the web in *realtime* and in *3D*!

**3D GIS** - There's been a lot of buzz lately about 3D GIS...and...many of you have heard about some of the work that we're doing in this area. SiteBuilder 3D' is a new product that is currently under development at MultiGen-Paradigm. SiteBuilder 3D is a plugin or extension to ESRI's ArcView desktop GIS system. The tool is designed for any ArcView GIS user who wants to

rapidly create and interact with realtime 3D scenes. SiteBuilder creates an OpenFlight model directly from data stored in ArcView. Our plans are to release this product sometime towards the end of this year. At the AEC Systems 2000 show, we were thrilled to be awarded a show-stopper award from CADENCE Magazine. CADENCE awarded this to SiteBuilder 3D for demonstrating the most innovative 3D GIS application they have seen thus far. If you have specific questions regarding this project, please email me at: [jonathan.zucker@cai.com](mailto:jonathan.zucker@cai.com)

**Services Group** - MultiGen-Paradigm's professional services group has been quite busy lately working on numerous urban simulation applications. Most recently, the group delivered the first version of our California Department of Transportation application. This application includes a 2.5 mile stretch of a Southern California interstate highway along with alternatives for sound walls, paving, signage, landscaping and road configurations.



Continued on page 5



Our City of Cerritos project includes the city's plans for a new city center development. Matt Pritchard, from our Content Creation Group is the lead modeler on this project. (see page 7 for more information about this project)

**Webcast Seminar** – On June 14th, we tried something new – an urban simulation seminar delivered on the web! Hewlett Packard, a new hardware partner helped sponsor this event. Participants dialed into a conference call and logged onto a special website. We then, through a combination of a PowerPoint presentation and videos, presented the benefits of urban simulation.

The presentation was then followed with an interactive Q&A session where attendees submitted their questions through a special chat feature. We were pleased to have over 70 people attend this seminar and are considering delivering more of these types of events in the future.

**Urban Simulation is stronger than ever** – After focusing on this new market since 1999, we are seeing continued growth and demand for Urban Simulation. We are now seeing cities, architects and engineers ask for realtime 3D visualization applications. Our customers continue to deliver new Urban Sim

projects to their clients and for their internal use. MultiGen Creator and Vega are clearly the leading tools for building realtime 3D environments for deployment in these types of applications. Finally, our joining the Computer Associates family has considerably broadened our ability to provide products and services to the Urban Simulation and AEC communities as well as strengthen our product development efforts.

Questions, comments – you can reach me at:  
jonathan.zucker@cai.com

## Fast Closest Point on a Polygonal Mesh and Collision Detection

By André Guézec  
Engineering

Computing the Euclidean distance from a point to a complex polygonal shape is a fundamental problem in computer graphics. Distance carries more information than occurrence or non-occurrence of collision, because it permits prediction, use of coherence, and dynamic path modification.

Our algorithm uses a multi-resolution hierarchy of bounding volumes generated by geometric

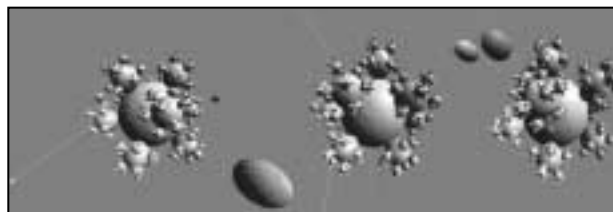


Figure 1: Three frames of an animation depicting spheres falling on a deforming mesh. (red denotes collision)

simplification. As the mesh refines, improving closest point estimates appear to sweep the mesh until the true closest point is found hence the name of the algorithm (Fig. 2).

The refinement process can be interrupted at any time, providing an approximation to the distance. Otherwise, the final result is the exact closest point and distance, within floating point precision.

Our algorithm is dynamic, exploiting full coherence between subsequent queries (without caching the closest point).



Figure 2: Mesh Sweeping process: As a spherical particle falls towards a torus, the torus mesh is refined in the vicinity of the closest point to the particle, which is indicated by a small sphere, and is connected to the particle by a line.

Our dynamic method also applies to a mesh that deforms, as illustrated with a simulation of particle dynamics (see Fig. 1).

Achieving from about 500 to several thousand queries per second on complex polygonal shapes (50,000 triangles), our method has applications both for interactive and photo-realistic graphics.

**Bounding Elements** - While various types of bounding elements could be accommodated (axis- or shape-aligned rectilinear boxes are a common choice), we have chosen as a bounding element the set of points in space whose distance to a shape portion is less than  $\Sigma$ . In the plane the elements are formed with segment-aligned rectangles capped with two half-circles.

Referring to Fig. 3, the distance  $d_o$  from  $p$  to the portion of the shape  $S$  contained in a bounding region  $R$  is such that  $d - \Sigma \leq d_o \leq d + \Sigma$ , where  $d$  is the distance to the shape portion defining  $R$ .

**Priority Process** - After computing the distances to all regions at the coarsest level of the hierarchy, each region is associated with an interval of the type  $[d - \Sigma, d + \Sigma]$  and indexed in a priority queue. When the key used in the queue to assign priorities is  $d - \Sigma$ , the interval listed in the front of the queue represents a minimum bound to the Euclidean distance between the query point and the shape. Fig. 3 shows this option, where the front of the queue is on the left side. The  $d + \Sigma$  value corresponding to the leftmost interval provides an upper bound to the distance. This upper bound can be used to prune all the elements of the queue whose key exceeds the bound.

**Small Motion of the Mesh or Query Point** - Each interval in the queue is expanded on both sides by an amount equal to the

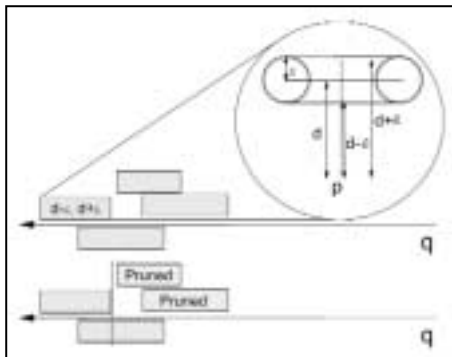
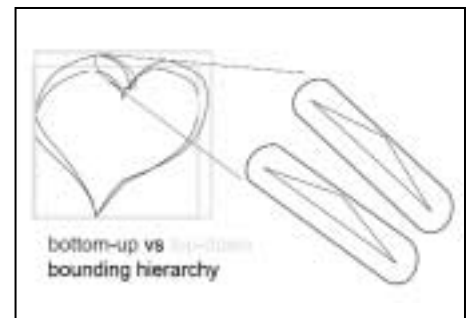


Figure 3: A priority structure  $q$  represents each region of the hierarchy as an interval. An upper bound to the distance is used to prune the queue.

magnitude  $\Delta$  of the motion. In this way we have a correct bound on the distance, however conservative. The priorities are not affected, because each interval is expanded by the same amount. The intervals are expanded all at once, by-passing the priority queue mechanism, and the logarithmic costs involved.

**Non-Rigid Motion of the Mesh** - When comparing previous bounding volume hierarchies with an error-bounding mesh simplification, mesh simplification computes bounding volumes locally, in a bottom-up fashion, instead of a top-down fashion.



For a smooth deformation, the motion of the mesh can be well approximated locally by a rigid transformation. Hence our algorithm will produce almost the same bounding volumes, albeit rigidly moved. This technique was used to produce collision detection animations with a mesh that deforms.

### **Congratulations**

We are pleased to announce and would like to congratulate Christian Cole on his new position as Vega Product Manager. Christian has a very proactive approach to product management and is well versed in the technology. He has been a great team player and we're confident he'll excel as a team leader for Vega.

### **AEC Systems 2000 Show**

A few months ago, David Weisberg of AEC Automation Newsletter expressed some concerns about MultiGen-Paradigm being acquired by CA in that it may mean the end of our commitment to Urban Sim. Jon Zucker had a very positive visit with him at AEC Systems show after the interview Weisberg commented:

" ....we voiced concerns that the company's urban simulation activities might get lost in the new organization. It does not appear that this will happen. CA is hard at work expanding the company's graphics capabilities to include a broad range of new services. As an example, the graphical simulation software can be linked into building alarm, electrical and HVAC systems to quickly show where

problems are occurring. We can envision a host of applications for this software"

Weisberg is referring to the Unicenter application that was demonstrated live at the AEC Systems 2000 show. MultiGen-Paradigm's ability to deliver solutions to the Urban Sim/AEC industries has expanded significantly by offering realtime 3D for Urban Simulation, e-commerce technology and assessment offerings, enterprise visualization support linked to Unicenter.

### **City of Cerritos Urban Simulation Contract**

The City of Cerritos, California awarded MultiGen-Paradigm with a new contract to construct a

switch models from the existing town center to the proposed new facilities. The use of realtime 3D visualization will enable Cerritos city officials and citizens to visualize and evaluate proposed developments within context and from any viewpoint.

MultiGen-Paradigm's professional services group will utilize their modeling and simulation tools MultiGen Creator™, a 3D modeler, and Vega™, a realtime simulation development environment, to build the model. Using aerial and digital photographs, CAD data, GIS data, terrain elevations architectural renderings and site plans for source data MultiGen-Paradigm's realtime 3D modelers will build the civic center model that will include the city hall, council chambers, sheriff's station, new library and parking structures.

The City of Cerritos has also purchased MultiGen-Paradigm's Multigen Creator™ modeling software along with training and consulting ser-

vices that will allow the city to make enhancements to the civic center model and to develop future urban simulations for Cerritos.



realtime 3D urban simulation application to visualize the city's proposed civic center complex. MultiGen-Paradigm's state-of-the-art technology will provide operator control to explore the 3D model in realtime as well as interactively

# MultiGen Application: Interactive Port Design

HR Mardyn, a joint venture between HR Wallingford and McCallum Engineering Consultants is based in Wallingford, Oxfordshire and uses the MultiGen Creator modeling tool to create realistic models for use on their real time Navigation Ship Simulator.

The 3D models of ports and ships have to be created quickly, accurately and to tight time scales as the duration of a project is usually only a few weeks of which half of the time is available to produce all the models that are required. Each port model is built up of terrain, buildings and other shore based objects, navigation marks and vessels all fully textured with multiple levels of detail.

These 3D models are then integrated with bathymetric, tidal flow and wave data output from numerical or physical models

The simulator, which consists of a number of computers linked by a LAN with the visuals driven by an ONYX RE2 is used mainly for consultancy based work where clients come to HR Mardyn with for example, a proposed new port design. Specific mathematical ship models are then created and used to test the navigational aspects of the proposed design in a range of environmental conditions, during both day and night and reduced visibility.

Projects are carried out for clients from all over the world quite often



with the Pilots from the port concerned actually using the simulator to assist in the work.

As the study progresses, due to the ease of using MultiGen Creator, modifications to the original design can be quickly made and usually completed as one test is being carried out so that the changes can be tried in the next test. This ease of modification has proved very useful and successful in the past.

By getting people together who may not normally meet on a day to day basis such as Pilots, port engineers and scientists, the simulator can assist in developing a greater understanding of each others requirements. It has been known in the past for engineers to design a port entrance to minimize the effects of waves inside a port, but when tested on the simulator it was found that the ships could not enter the port. Finding this out at an early stage can be invaluable, rather than after the new port entrance has been built.

Once the final layout has been approved the simulator can also be used for training. This can enable the port Pilots to become familiar with the proposed developments.

It can also allow them to investigate and study aborting and emergency manoeuvres that may be most suitable to carry out if required.

## CREDITS AND COPYRIGHTS

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# Creating Real-time Historical Environments

Digital Artefacts, The University of Iowa, and The History Center have created a museum exhibit, "This Old Digital City" (TODC), that uses real-time interactive virtual environment



technology to immerse visitors in a 3D reconstruction of turn-of-the-twentieth-century Cedar Rapids, Iowa. Museum visitors operate a "time machine" to explore the city and to access multimedia content associated with buildings and other historically significant sites.

Recent developments in PC graphics hardware and software have opened the door to application of virtual environment technology in domains beyond the military and entertainment. TODC powerfully demonstrates the effectiveness of virtual environments for historical and educational applications, providing an engaging and effective interface to historical archives. In traditional museums, floor space constrains the amount of data that can be presented. A virtual reality interface to such material addresses not only preservation and space concerns, but adds important spatial context; archival historical content is directly connected to physical location via the

real-time 3D environment.

**The Exhibit** - TODC combines (1) a large real-time 3D visual database representing twenty five blocks of Cedar Rapids circa 1900, (2) multimedia historical content associated with buildings and other locations, (3) an immersive environment consisting of three 6'x8' rear-projected screens driven by four networked PCs, and (4) a "time machine" interaction device.

Museum visitors control their journey through the restored city; the environment is not pre-rendered nor the paths of travel prescribed. When touring, visitors encounter animated humans who indicate availability of multimedia content associated with a site (e.g. by saying "Hello, would you like to take a look at my shop?"). Multimedia content was produced from scans of black-and-white and sepia-toned images, with panning, zooming, and other effects, along with accompanying music and narration.

User-controlled exploration of virtual environments can be

immersive, engaging and entertaining. However, allowing full navigational freedom can conflict with pedagogical goals; e.g. how do we get visitors to go to the "right" places? The initial installation is

designed around five- to ten-minute experiences in which visitors have free control but are enticed to access content. Our experience in driving and bicycling simulation shows that some people are uncomfortable with the full freedom afforded by virtual environments; they prefer simply to be "shown around". So, we also provide "guided tour" scenarios in which software controls gross motion paths while visitors retain control over fine variations (this is analogous to amusement park rides in which a vehicle is loosely coupled to a guiding rail). For TODC and future exhibits, we are developing techniques that integrate methods employed in story telling, theatre, and cinema to enable authoring immersive virtual experiences and educational narratives.

## Historical Model Construction -

Construction of the 3D model – buildings, streets, sidewalks, and other artefacts - was both the most

technically difficult as well as most interesting component of the project. Urban renewal programs in the mid-twentieth century destroyed nearly all circa 1900 buildings (replacing them, usually, with architecturally less interesting



ones); only six of the 100+ modelled buildings remain standing.

Construction of the 3D model, then, had to rely on historical data. The key materials included photographs, postcards, newspaper images, insurance maps, city



records, blueprints, historical reference books, and present-day GIS data (modified to reflect known differences). Managing and georeferencing collected data posed a substantial challenge. Digital Artefacts is developing tools

that facilitate geospecific model creation by providing convenient map-based access to and management of image, video, and other data.

The primary modelling tool used for TODC was MultiGen Creator. Building geometry was constructed from information in images, blueprints, and maps. Because TODC visitors examine buildings at close range (compared to flight simulators, e.g.) high-resolution textures were needed to maintain visual fidelity. Thus, TODC requires graphics cards with 64 to 128 MB of texture memory, which has not previously been available on PCs.

We wanted a colorful restoration, so textures could not be created by simply scanning the available black-and-white or sepia-toned photographs. Starting from scanned photographs, we built a library of “digital artifacts”: windows, frames, doors, awnings, etc. To faithfully colorize these elements, some of which (e.g. pressed tin cornices) are no longer used or seen locally, we worked closely with architectural historians and reference materials.

A critical challenge in creating a historically faithful geospecific model was communication between several disciplines - art, real-time computer graphics, architectural history, cartography, and museum archives. For

instance, modelers, artists, and historians had to work together to decide which elements of, say, an ornate Victorian building, could be represented while remaining both historically representative and technologically feasible (given polygon, texture, and person-time constraints).

**Impact** -TODC represents an exciting mix of cutting edge technology and liberal arts content. The exhibit emphasizes this through an associated kiosk, “The Making of TODC”, that shows visitors how technology was applied to history. Furthermore, TODC expands horizons by demonstrating new application areas for virtual environments.

Students from local schools participated in the first phase of TODC development, using city records and museum archives to research historical content. We are developing software tools for schools that will enable students to develop historical content and to integrate it within TODC and similar environments.

## Meet the Vice President of Sales

Dave Rolston, our president and CEO, has offered me the opportunity to introduce myself to you via this TakeFlight letter. Given the fact that I am in sales and a former teacher, I never pass up a chance to speak to a crowd, therefore I am happy to accept Dave's offer.

My name is Chris Hawkins, and I am now the Vice President of Sales. You may have known me as the International Sales Manager (a.k.a. Frequent Flyer, World Traveler, Luggage Schlepper), which I have been serving as for the past year. During this time I have worked hard at increasing our growth worldwide while also strengthening our relationships with our distributors. The position of International Sales Manager allowed me to not only travel to many beautiful places throughout the world and begin to understand the dynamics of how business is done abroad, but more importantly it offered me an opportunity to learn about cultural differences and diplomacy. Going to countries whose history exceeded the United States by 1000's of years is a very humbling experience. It always amazed me that many architectural structures were older than our entire country. I found it fascinating working with our distributors and customers abroad. I thoroughly enjoyed the challenge



of attempting to understand what it was they were trying to accomplish, what was our part in it and all the while eating something, which could not be categorized by our 4 basic food groups.

Prior to that position, I worked domestically as the Central Region Sales Manager for several years. Traveling from state to state may not sound as exciting as traveling abroad, but I can tell you that I found it to be equally as satisfying. This is where I began to understand the significance of a true partnership and relationship as opposed to closing a sale. Working towards a common goal of solving a customer's need or problem allowed me the opportunity to become part of their work environment. There is no greater satisfaction than helping someone achieve his or her goals. (This is probably the main reason why I went into teaching, and stayed there for almost 10 years prior to coming to MPI).

Transitioning from domestic sales

to international sales was difficult for me initially. Not because of the vast differences in duties, but rather because of the relationships that you have to leave behind. After several years of working with our customers within one territory, you develop a friendship that exceeds the business relationship. Now, a few years later, I realize that job changes only allow you to work with those customers in different ways. Not leaving the relationship behind, but rather being able to offer your help in a different capacity.

I am extremely excited about this new opportunity, and I am confident that MultiGen-Paradigm will continue to create the market leading products that it has in the past. This industry we are involved in, seems to change faster than the Internet at times and attempting to change with it, is not always easy. However, working with the highest caliber engineers, support staff and management team makes those difficulties a lot easier to overcome. I look forward to working with all of our customers and partners in the future and helping them (as well as us) achieve our goals.

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