Technology and Redistricting:

A Personal Prospective on the Use of Technology in Redistricting
over the past Thirty Years

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Introduction

Over the past nearly forty years the American political scene has seen regular change brought about by the decennial census and resulting redistricting activity in nearly. every state. While initially envisioned as part of a great compromise by the Founding Fathers to deal with representation by both states and population, the Census and redistricting didn't grown in importance until the 1960s with the Supreme Court ruling in Baker v Carr. The following 1970 round of redistricting was mostly done with paper maps and adding machines. Districts tended to reflect larger levels of geography, like counties and townships, because they were easy building blocks to use and tally quickly.

My name is Kimball Brace, and I'm President of Election Data Services, Inc. For the past thirty years, my company and I have been in the middle of much of the redistricting activity that has happened in many states of the nation. In the past three rounds of redistricting, we have worked in more than half the states in the nation. As such, we have participated and helped develop much of the technology and databases that have become crucial elements in the redistricting battles. But our work has not stopped when each decade is just two years old. We have been involved in more than 65 court cases dealing with all relms of redistricting, including issues under the Voting Rights Act, population equality, district compactness, communities of interest, and a variety of census related topics.

This paper is designed to provide personal reflections on how technology use in redistricting has changed over the past thirty years. The information is based on personal

observations and involvement in many of the stories cited. The paper is organized historically to allow the reader to experience the change that has occurred.

The 1970s

I did not participated directly in the initial round of redistricting following the Baker v Carr revolution. However, I researched and observed the effects of redistricting as an intern with the Republican National Congressional Campaign Committee, and then as researcher and advance person with the NBC News Elections Unit. Following stints with Congressional Quarterly, serving as Associate Editor of Election Administration Reports, a nationwide bi-weekly newsletter devoted to the administrative issues of elections for state and local election officials, along with being Research Director for the Winograd Commission of the Democratic National Committee, I started my own company in 1977.

While undertaking a research project for the Federal Election Commission in the late 1970s, one day I was meeting with the prime contractor, Jack Moshman of Moshman Associates. Jack mentioned that something called redistricting was going to take place in the next several years, and that he had a computer program that could automate the process of drawing districts. Based on the initial, mid-1960s, work of Dr. Stewart Nagel from the University of Illinois, Moshman and his staff had developed a cobal based program that sought to create districts based on flexible criteria. Moshman offered his staff programmer to assist with running and modifying the program. The program allowed the introduction of both population and electoral results, but the heart of the database was a touch list. This list of every piece of geography in a jurisdiction showed

which other geography the initial piece touches. Because geographic information systems (GIS) were in their infancy, and geographic databases non existence, the touch lists had to be developed by hand. They allowed the program to know what geography could be added or removed from a district, as well as helped in determining the compactness of the resulting district.

The touch list requirement played a major part in determining the trial database that we initially used. We chose the State of Massachusetts because the 359 townships provided convenient building blocks for the program. Population numbers and estimates were readily available, as were election returns. Finally, early population projections indicated that the state was likely to lose a congressional district in the upcoming apportionment process based on the 1980 Census.

Over the next year we built the database, modified the program, and ran nearly a hundred scenarios. Even though we changed criteria, modified compactness requirements, and pushed alternative factors in their importance, each computer run seemed to indicate the same result. The automated program constantly pointed to the 8`h congressional district as the most likely to be eliminated.

As we took the program and results on the road to demonstrate and sell the services to state and local governments, attention soon focused on our results. The media also picked up that fact that we were saying that the Speaker of the House, Tip O'Neal's district was likely to be eliminated when redistricting took place. As history ultimately showed, however, the Speaker's seat was safe, and another district was eliminated by the legislature. Yet the experience showed that politics has as much, if not more, importance in any redistricting process.

Our work also gained the notice of friends at the Department of Justice's Voting Rights Division. In 1979, the City of Houston, Texas sought to annex additional territory but were denied pre-clearance under Section 5 provisions of the Voting Rights Act because they still had an at-large electoral system for it's city council. Needing the additional land, and it's tax base, the city agreed to change to a single member districting system. When they asked who could help them undertake this effort, my friends at DOJ mentioned they knew this crazy person in Washington, DC who was working with redistricting software, and we soon had our first redistricting contract.

Creation of the database consumed a great deal of time in the project. The building blocks that were use were the city's precincts, and a touch list was developed by hand reviewing precinct maps. Because of the significant population growth experienced by the City since the 1970 census, a demographer was brought in to create population estimates for each of the precincts, along with racial estimates. Dr. William Rives worked with school demographic data to generate new 1979 estimates for each precinct. The Director of the project for the City was Bernard Peterson, a staffer in the city's planning department. Peterson ultimately left the city to become Vice President of our company and chief of computer development for the computer products used during the 1980 and 1990 round of redistricting. The third member of the redistricting team was Bobby Bowers, head planner and demographer for the State of South Carolina. Bowers' preformed an important political role in the project, working with the city council to obtain their input into the district design.

While a number of computer generated plan alternatives were created, it soon became evident that the program was best at creating snake-like district configurations.

There was a compactness factor in the program, and even when placing all the emphasis on that one criteria, the computer still drew beautiful snakes. While we didn't have too much time to investigate, it appeared that the sort order of the database had a much bigger role in determining where the district would go next. The computer program did provide a very useful function, however, that of acting like a big adding machine. Inputting user-generated district configurations into the system, and letting it create summary reports relatively quickly, became very useful in determining the ultimate district boundaries.

The final activity of the 1970s actually took place early in the decade, but it's ¡mplementation would have significant impact on the 1980s round of redistricting. When redistricting took place in 1970, legislators were provided census data for geographic areas that the Census Bureau understood (Census Tracts, Block Groups, Enumeration Districts). However these were not areas that legislators recognized, nor that they understood. Legislators understood, and used, geographic areas called precincts (sometimes called voting districts, election districts or even polling places in different states). As a result, a number of organizations, lead by the National Conference of State Legislators, went to Congress and got a bill passed in 1975 to recognize precincts. Called "Public Law 94-171", the legislation set up a voluntary program where states could provide alternative geography (ie, precincts) to the Bureau and receive population data tallied to that geography when the Census results were released. States had to follow Bureau created guidelines for the program, but at least they got precincts.

The 1980s

Unfortunately, going into the 1980s round of redistricting, the Bureau's guidelines for participation in the PL program proved problematic for many states. In order for the ultimate published data to match up with the precincts in existence when the data came out, the Bureau recommended that states' freeze their precinct boundaries by April of 1977. With the large degree of population increases in many urban areas of the nation, and an upcoming presidential election, county election administrators squawked at not being able to make changes to their precincts. As a result, only 15 states participated in the first option of the "PL" program. Twenty nine states conducted an "alternative approach" option whereby they took listings of block numbers and enumeration districts and associated them to their precincts. Census Bureau staff assisted many states in undertaking this effort. In addition, five states (Georgia, Mississippi, New York, Rhode Island and Virginia) contracted with the Bureau to generate statewide blocks, even in the rural areas. Six states (Colorado, Hawaii, Massachusetts, New Mexico, Vermont and Wyoming) did not participate in any aspect of the Election Precinct Program, as it was called.

For 1980, the Census Bureau used census blocks (like a city block) in urbanized areas, but larger enumeration districts in rural parts of the nation. All of the geography was delineated on large 3'x4' paper maps that were generated in the Bureau's Jeffersonville, Indiana multi-building complex. Draftsmen created stick maps by hand and labeled the geography with stick-on labels. Many times when the originals were used to generate "blue-line" copies for the states, a block number would fall off. The

"blue-line" paper maps were generated via an ammonia-based process, and required many a user to operate in only well-ventilated rooms.

Besides geographic issues, the actual 1980 Census data provided some technological challenges. The first complete computer file of census data, called the "PL-file", was provided to states for redistricting purposes in February and March of 1981. The file provided total population counts for each piece of geography along with breakdowns of the five racial groups used in that decade: White, Black, American Indian, Eskimo and Aleut, Asian and Pacific Islander, and Other. All persons were also asked whether they were of Spanish Origin, using different wording than what is now used for later Censuses, and significantly different from the 1970 methodology of tallying Spanish Surnames. Because Spanish Origin was a separate question, one could not add all the race information together with the Spanish Origin because it would add to more than the total population. But, the Spanish Origin information was cross tabulated by race, which allowed users to develop new subcategories that would add to 100 percent. We created Non-Hispanic White, Non-Hispanic Black, Non-Hispanic American Indian, Non-Hispanic Eskimo, Non-Hispanic Asian, and Non-Hispanic Other categories that then could be added to the Hispanic numbers and reach 100% of the population.

The Census Bureau did not provide voting age population (VAP) breakdowns in the PL file in 1980. But because VAP provides a better breakdown of the potential electorate (with whom the legislators are most concerned), particularly the racial makeup of the electorate, the need for such information became a large issue in the 1980 round of redistricting. In the second half of 1981, the Census Bureau began releasing more extensive data from the 100%, short-form questionnaire. The files took two forms, first

the STF (for Summary Tape File) -lA file that contained geographic records down to the block group, and then the STF-1B file for all the blocks. Age information was contained in the file, which allowed a computer programmer to tally up the age information into Voting Age Population data. However, the Census Bureau did impose suppression rules for any cell that contained less than 15 persons. As a result, we developed an elaborate program designed to take information from both the PL data and the STF files, as well as all the geographic levels, and create a large data cube. By reviewing both the row information and the column data, one could, in essence, un-suppress the data.

There is a fundamental need in the redistricting process to make sure data adds up. Lower level geography needs to add to higher levels, all the racial designations need to add to the total population. Making sure that all districts add to the state total guarantees that nothing is left behind. Computer programs back then, as well as the newer GIS systems used now, add up the data from the lowest possible geographic level to make up a district configuration. Suppressed data or missing data means the programs will give false answers or take much more time to create the right answer. Because redistricting is a very contentious process, any error can be the death of a plan if it is discovered.

The first state we did in the 1980 round of redistricting was Illinois. We were contracted by the Minority Leaders Office on the House side of the legislature.. The first, and most important task was to begin building the database to be used in the redistricting process. Illinois participated in the "alternative approach" precinct program with the Census Bureau. In order to match up the state's 11,000 precincts with the approximately 100,000 census blocks, we created an old IBM white punchcard for each census block

and a pink punchcard for each precinct. The entire summer of 1980 was spent with students at a Springfield, Illinois union hall auditorium with the blue-line census maps and precinct maps collected from each of the 102 counties and 11 independent city election boards. The student's job was to draw the precinct boundaries onto the census maps (made difficult by various scales of each set of maps), and then determine which census blocks were located within each precinct. The white block punchcards had to be located and placed behind the correct pink precinct punchcards. At 2,000 punchcards in a normal punchcard box, we had 50 boxes of white cards and ten boxes of pink cards. Yes, some of the boxes were dropped once, and the work had to be redone.

One has to remember that in 1980 there were no such things as PCs (they didn't come into being until the 1983/4 time period). There was no GIS programs, and there was no electronic map database available for use. Computers were mainframes, and in Illinois we were able to purchase computer time from the biggest bank in the state that had an operation in Springfield. However, the computer time was only available after they had processed all the day's checks and accounting, usually not until after 9pm each day.

Once the geographic part of the database had been built and submitted to the Census Bureau, the political data, (or election returns) had to be gathered and keypunched. It soon became apparent that multiple years of election data were desired to be able to generate trend analysis, but because precinct boundaries change over time, multiple geographic equivalencies were also required. All of the election returns were processed through the equivalencies and disaggregated to the census block level. This

facilitated the speed of the ultimate redistricting program, which could simply add hundreds of cells of data for each census block to come up to a district total.

While there was an initial effort to create a touch list for the automated district generating program, it soon became apparent that the program could not handle multiple levels of geography. The program was abandoned and new tallying system programs and a wide variety of reports were generated.

Because the 1980 round of redistricting was all done with paper maps, the most valuable commodity was wall space. The minority leader's office in the State Capitol was a full two story high ceiling office. We discovered that we could mount the entire City of Chicago's Census maps on one wall of the office, with ladders then used to help read census block numbers from the maps and draw on two story high rolls of acetate with magic markers. At the heart of the redistricting effort, every day was spent up on the ladders, calling down census tract and block numbers to other staffers who would code 80-column keypunch sheets with the geography and district assignments. At 6pm each day, staffers would take the coding sheets and head for the bank, where they would convert the keypunch sheets into 80-column punch cards. At 9pm the computer programs were started and thousands of cards read through the card reader. The program took all night to run, but by 4-5 am the printer started producing a two foot high stack of reports that both summarized the data for each district and produced a master list of all the geography in the plan. At that point, we'd go back to the leader's office and do it all again.

With Illinois well underway, Election Data Services, Inc. also received a contract from the Democratic party in Michigan. The database was created in much the same

manner, lots of different colored punchcards and lots of volunteers. But we added a unique component when we teamed up with Democratic political consultant Matt Reese, who undertook a cluster based survey using the cluster system developed by Claritus Corp. Using the cluster information, we were able to incorporate the survey results into the redistricting database. An extensive district reporting system was developed that would report the election results for contests back to 1974, the demographic data from the census, the survey results, a listing of the higher levels of geography incorporated in the district and what percent of the district was attributed to the various geographies, and a crude scatter-plot that showed the election returns percentages over time. A report with a page for each district was generated each time assignment changes were made. Computer time on a mainframe from a computer service bureau was also purchased and the program was run daily. Luckily, the service bureau was located next to the Lansing airport, since there were numerous flights back and forth to Springfield, Illinois.

Both Illinois and Michigan redistricting efforts that decade ultimately resulted in court cases. With that began my experiences as an expert witness. Technology played a roll here too, or the lack of technology. Because there was still no GIS mapping system in existence, hand colored maps had to be produced. During one trial in Chicago, law clerks were utilized to color pencil different demographic characteristics and concentrations for all the census block groups in the city. A map took an entire day to generate, and numerous times a new request was made to change the percent breakpoints in the data. It wasn't until several years later when the first mapping software package (called StatMap) was produced by President Jimmy Carter's son Chip and users could finally see on a computer screen what a map would look like.

More court cases consumed much of the 1980s as various issues under the Voting Rights Act were litigated. During 1983 and 1984 we were employed by the Department of Justice in their preclearance of South Carolina's state legislative district redistricting plan. A major concentration of the effort was to develop an elaborate database of historical election returns and demographics, and then using that to analyze the racial bloc voting patterns in the state for a number of years.

The need for accurately depicting precincts as they change over time was a focal point in much of the litigation and database work and still exists today. Many times precinct boundaries will stop at a city boundary. Yet, over a decade a city may annex new territory and change the city boundaries. In most instances the precinct boundaries will also float to, or be adjusted because of, the annexation. However, the Census Bureau only records into their geographic products the city boundaries as they exist at the time of the Census. This makes it impossible to accurately depict the precinct boundaries over a decades' time and then to equate the demographics to the electoral behavior of the area. Failure to take this into account in database development can cause problems in racial bloc voting analysis. I have long fought the Census Bureau over this issue, but to date have not been successful in getting the Bureau to change it's policy.

While court cases continued to be the focus of much redistricting activity during the 1980s, the later half of the decade began to focus on getting ready for the 1990 round of redistricting. The Census Bureau's precincting program was broken into two phases for all states. Phase 1 (called BBSP for Block Boundary Suggestion Project) allowed the states to recommend new block boundaries, in most instances so that they would correspond more closely to precinct boundaries. One of the sticking points, however,

came with the Bureau's guidelines that the new block boundaries must follow visible features on the ground. The Bureau's reasoning was sound, after all, how could a census enumerator know for certainty that a house was located in a certain census block, if those block boundaries were in thin air. Unfortunately, precinct boundaries many times do go through thin air. In the Midwest and West, sectional boundaries many times form precinct boundaries. Because the Bureau hasn't recognized that fact, precincts can be only approximations in the census geographic structure. Yet, these approximations can cause anomalies and outright errors when doing detail analysis for issues like racial bloc voting. Reflecting that the precincts were really approximations, the Census Bureau called this new geography Voting Tabulation Districts (or VTDs).

Phase 2 of the Redistricting Data Program conducting in 1989 still required that participating states draw their precinct boundaries onto Census generated paper maps. We assisted a number of states in both phases of the program and then Bureau personal inserted the precinct boundaries into a new database. Thirty eight states drew precinct boundaries for their entire state, another four states covered a major portion of the state, four more states covered from a third to half of their state and Kentucky, Mississippi, Montana and Oregon failed to participate at all.

During the 1980s, the Census Bureau was developing something that would revolutionize the redistricting process. In cooperation with the United States Geological Survey (USGS), the Geography department of the Census Bureau created the first seemless electronic map of the entire United States. Called TIGER (for Topologically Integrated Geographic Encoding and Referencing database), the system provided the base for use with new software packages that could draw maps on a computer screen. No

more ammonia smelling maps, nor having to buy up all the acetate in a state. Incorporated correctly, the software packages (called Geographic Information Systems, or GIS) could even develop color coded maps showing levels of concentrations for any data item. But most sophisticated GIS packages of the time were still mainframe based, such as Arclnfo from ESRI.

The 1990s

Don Cook, formerly from the Census Bureau, created a company called Geographic Data Technologies (GDT) to initially help the Bureau to create TIGER and then to expand the database's capabilities and accuracy. The basic work of the company made heavy use of GIS technology and his company soon developed the first linkage of spreadsheets to a map. The "spatial spreadsheet" concept allowed a user to draw an area on the map and then the spreadsheet would immediately show summary totals of data items in the database. Called "GeoMap", the PC based software package was the first true software package that could meet the needs of the redistricting community. Election Data Services, Inc. helped market the system to states, and our staff developed complementary data development processes and extensive reports.

But PCs were still slow and hard drives small when compared to modem day usage. In order to handle the massive size of the Illinois database, we linked together two, 25 MHz personal computers in order to provide enough processing capability to handle such a large state. The software had the capability to recompute just the area on the screen or the entire state. Most users discovered very early the advantage of the more

limited computations. Retallying the entire state of Illinois usually took slightly more than an hour.

During the 1990 round of redistricting, technology was still in the hands of very few. The software packages were still expensive, and the database development efforts too extensive for all but a view hard core users, such as state governments. The TIGER files vastly improved the ability to create the large databases needed in redistricting. While many states relied on just the single set of precincts incorporated into TIGER, we greatly expanded the historical precinct configurations so that important trend line political data could be utilized.

TIGER also allowed for more accurate compactness calculations to be generated on plan configurations. For one of the states to whom Election Data Services, Inc. provided extensive assistance, software and database development services, the compactness capabilities were extremely important. Iowa is the only state in the nation that has the actual compactness formula to be used in redistricting, written into state law. But we discovered that all that accuracy can actually have a downside. The more exacting measurements available in TIGER sometimes generated compactness scores that were just over 1, on a scale of zero to one.

The initial round of the 1990s redistricting tended to maximize minority voting strength. Partly due to interpretations of the meaning of the court decision in Thornberg vs Gingles from North Carolina, the technology also facilitated this maximization policy. For the first time, TIGER geography and GIS software allowed users to see where concentrations of minority members lived, and then to creatively draw districts to encompass those concentrations. Fueled by the activists pushing for more, and the

Republican party smartly realizing they would also be the benefactors, the 1990 round of redistricting saw an unprecedented increase in minority seats. The so-called 1-85 district in North Carolina, the Z districting in Louisiana, and the wildly configured districts in Texas were all examples of where technology played a significant role in redistricting.

But just as technology helped to create these districts, it also played a role in tearing them down. Computer generated maps were utilized to demonstrate to courts how strangely the districts appeared and how non-compact they really were. By the mid-1990s, the Shaw v Reno line of cases overturned nearly all the egregiously configured districts.

While court cases continued throughout the decade and kept Election Data Services, Inc. in business, planning for the next round of redistricting in 2000 was already well under way. With TIGER in more widespread use, the Census Bureau modernized the Precincting Program for PL94-171 to allow states to accomplish both Phase 1 and Phase 2 activities electronically. Election Data Services, Inc. developed GIS based programs that were specifically designed to facilitate the Bureau's guidelines for the program.

The 2000s Round

But the increased power of PC technology and the lure of other business, brought two other important players into the redistricting business in anticipation of the 2000 round of redistricting. Caliper Corp.of Massachusetts utilized it's own GIS base package to develop a program called Maptitude for Redistricting. Digital Engineering Corp of Maryland built it's redistricting software (called AutoBound) using the core GIS package

of ArcView from ESRI. Both companies developed side modules that allowed states to participate in the Precincting Program from the Census Bureau. Because Election Data Services, Inc. also used ESRI based GIS software, we ultimately formed a cooperative marketing agreement with Digital and utilized AutoBound for redistricting in the states we assisted.

The effect of more competition in the redistricting business meant the price of software shrunk. As an example, software was sold for $60-75,000 in 1980, for $20,000 in 1990, and then just $3,000 by these two companies in 2000. As a result, more organizations and individuals purchased the product, as did many more county and local governments.

However, the database still provided a critical element in the technology use. The 2000 Census for the first time allowed individuals to identify themselves as belonging to multiple racial groups. A person could mark that they were both African American and White or were even a combination of all six racial groups. As a result, the PL data from the Bureau ballooned in size. While in 1990 there were 12 columns of data in the PL file that year, by 2000 there were 265 columns of data. Luckily, the cost of hard disk storage had greatly decreased. The impact of this massive census dataset has not greatly affected the redistricting process, however, in that no subsequent court case has weighted in on how to interpret the data. The recent Georgia redistricting case decided by the Supreme Court did give approval to how the state used counts of African Americans, but they didn't decide when multiple minority groups were present in a state.

Conclusion

The technology used in redistricting has changed dramatically in the past thirty years. Personal computers are now common place, and their speed and storage capabilities has grown in leaps and bounds. But the databases used in the process have also grown in size and complexity and if they are not put together right they can bring down a plan no matter how nice the software functions. Yet, for all the improvements and changes, the words of a dear friend and fellow redistrictor still ring true. The late George Meier of Florida once said, "All the software are just tools, it's the hands on the mouse and the mind behind the plan that will determine whether you are successful". That hasn't changed in thirty years.