Personal Research Journey

Becoming a member of the faculty

How does one become a member of a faculty? Little boys and girls never say they want to grow up to be a professor. Oh they might be persuaded to say they wish to teach, as they get older but a professor? My observations suggest to me that people who end up on a university campus never wish to stop learning. Their thirst for knowledge cannot be quenched. This starts at a very early age. Learning is exciting! Connecting dots within that learning process becomes exhilarating. Recently, I was asked to speak on professional development. Within that content I noted three main points:

1st) Your career should be your passion. Never pick a career for the wrong reasons—salary, location, and peer & family pressures—all bad reasons. There is only one reason to use in selecting your career path—passion. You have to love what you do. You must feel (down deep) that you can make a difference—you see opportunities others do not see. If you do this, all other things will come. If you love your work—you will spend the time needed to put you at the top. Recognition comes in the form of income, awards and the respect of your peers and family. You will have a happy life! It all goes together. This does not mean your life will be easy but you will not spend your entire life looking for something different and never finding it.

2nd) The second point involves developing and protecting your good name. In the end, your reputation is the essence of who you are. Most of us spend our entire careers developing our good reputation. We become role models (like it or not), we promote honesty and high integrity. Do nothing to harm that reputation. Do all in the most ethical way. Never lie, never take credit for what is not yours and never give credit where it has not been earned, no matter the good intentions.

3rd) From a purely academic perspective we know that the M.S. degree is guided research and the Ph.D. degree is basic independent publishable quality research. Many in academia believe that the Ph.D. is purely an academic exercise—to prove one can do independent research-period. I know there is a place for some of this, however I have always believed it was our responsibility to, yes, do cutting edge research but also it should unlock a door, or lead (in a reasonable timeframe) to a result that increases the quality of life for all of us. I have instilled this in all of my graduate students. I believe, their success and happiness, can be somewhat tied to this point. My graduate students have played key roles in forming eight start-up companies. These companies have all started at the lab bench or computer screen at NCSU, and all became commercial in North Carolina. All still exist and all are profitable. Four of these companies have resulted in four different Institute of Food Technologist’s Industrial Achievement Awards!

Pick a career where you have passion. Always be honest and use the highest level of integrity. Make your work count—solve a problem; unlock a door—increase the quality of life for all of us.
How I started:

Yes, I was one of those boys that always torn things apart to see how they worked. I was very fortunate that I had a Dad that knew how to make things. He had tools that to this day I have no idea what they do. If something broke, he fixed it. I had two older brothers that learned what all the tools were and how to use them. Some of this remotely fell on me, but I never got the fix up the old bug fever. I always wanted to create something new. I, like so many, was absolutely captivated by the space program. Going into space seemed like the ultimate. I built rockets-some that worked and one that today would be classified as a pipe bomb! I had picked my career very early in my life and I was preparing myself for what I thought was needed. I had it all figured out-go to college, major in aerospace engineering, enter the Air Force (astronauts in those days were pilots first), and then get accepted into the world of NASA. All was on track until between my freshman and sophomore years I was told that my eyes would never allow me to pilot any craft. I had no depth perception. Dreams, my future, my entire focus was dashed! I had no back up plan. Being an aerospace engineer and not ever being able to enjoy the true use of this knowledge in my chosen field of work did not make sense. During my “what am I going to do” phase of my undergraduate education I was most fortunate to meet a professor who would truly change my life-Dr. Vic Jones. He was, of all things, a process food engineer-a what? Processing food-this was a serious engineering career? I quickly learned that this was one of the most difficult and demanding careers an engineer could ever select. I learned that all the fluid, heat and mass transfer courses were perfect fits to the challenges within this world of processing food. The exact same equations that are used to calculate drag and flow over an airfoil were the same equations used for food being pumped in a pipeline. I may not pilot a craft but I could pilot a process-a crazy turn of events. After my B.S. I moved a thousand miles from home to be a project engineer for a food and pharmaceutical equipment manufacturer. I was rapidly introduced to aseptic processing. We were doing projects in food processing in Europe and pharmaceutical companies in the US relative to aseptic processing. I had found my place in the world. I saw aseptic processing as completely changing the food industry. All the products that were retorted would some day be processed aseptically (sterilized separate from the package, during continuous flow versus the in can heat treated traditional canning operation). I needed more education. In the early 1970s there were only two US academic programs in aseptics—Purdue (Phil Nelson’s program in acid products, primarily tomatoes) and North Carolina State University (where a critical mass of engineers, microbiologist and chemist worked on low acid foods, primarily dairy). I was from North Carolina—the decision was a non-starter. After my M.S. degree I again returned to industry as an engineering consultant. Again, after two years, I returned to graduate school while working full time as a research technician. This was my true start to an academic career. As a technician I actually was given the responsibility to coordinate efforts from a multitude of disciplines on a very large dairy industry sponsored project on aseptic processing. A feeling of contribution and ultimately an opportunity to increase the quality of life for many became my life’s work.

In July of 1980 I was most fortunate to have the opportunity to join the faculty at North Carolina State University as a tenure track assistant professor. I was green but not all that
green. Although there has never existed a requirement that the research ever had to lead to anything that might some day increase the quality of life for all of us (it was thought of as an academic exercise to prove one could do it), I always had an eye on changing processes for all to benefit. Maybe this came from my industry experience, or maybe it came from my Dad and older brothers. Wherever it came from, I had it. I instilled that concept into all my students and post-docs and the results have been several patents and eight companies. Through this voyage of 33 years, at faculty rank, I have learned far more than I ever expected. I hope in some way this story will be of help to all who follow, as this deviation from the normal professor’s life was never designed nor anticipated. While in industry I constantly asked why was it done that way. The answers always revolved around the same theme—“We have always done it that way.” To a person who had to know why things worked this answer was a supreme challenge.

**Research/Discovery**

As a faculty member my first encounter with the then new intellectual property committee was with an apparatus I called the ‘Continuous Flow Kinetic Data Generator (KDG).” I am still not sure why I knew to submit a disclosure—it was not commonly known or common practice. However, somewhere I got the impression that it was a faculty’s responsibility to disclose. The theory in my disclosure was sound but I had never made one. The committee had enough experience, but limited in funds to ask three basic questions.

1) Do you have anyone to pay the patent costs?
2) How many would you expect to sell/year?
3) What would be the selling price/profit margin?

Needless to say I was at a loss for these answers. I had not even made one of these lab directed apparatuses. About 6 weeks later I got a letter from the committee giving me free title to the property and they (the university) had no interest in pursuing a patent. As a young non-tenured assistant professor with very limited resources and a young family I asked myself what do I need? I needed publications and work toward obtaining tenure. Thus, I published the work. My value system at that time was based on keeping my job. In academic, if you are in a tenure-track position, you keep your job by obtaining tenure in a timely manner.

**Listen to your students!**

Along the way I was able to hire a technician (John Miles) whose first assignment was to make one of these KDGs. I have to admit he did a wonderful job but it was one ugly apparatus. If one valve would do, he put two. In any case, within a year seven faculty members were scheduled to use the testing equipment. Understanding kinetic changes in constituents of thermally heated biological materials during continuous flow was a hot area and no real useful equipment or protocol existed until this unit was built. Often people from industry visit our pilot plant and they would always ask—what is that? John would spend time talking to them. At the end of his Ph.D. requirements I learned he had been making these units in his condo for industry for a couple of years. When I asked what’s after the Ph.D., he answered “I think I will go into business for myself.”
Microthermics was born and has existed for over 20 years, winning the 2011 Institute of Food Technology Industrial Achievement Award. Since all the technology was in the public domain Microthermics was free to use any and all of the know-how.

As a young assistant professor I was fortunate to acquire a brilliant young Iranian student who had just the background in physics and mechanical engineering I thought I needed for my research direction. We needed a project and a colleague (Hershall Ball) came along with the perfect challenge. At that time the Center of Disease Control contributed a large number of our country’s foodborne illnesses to eggs-mostly due to undercooked shell eggs. The US did have egg pasteurization (~ 300 million lbs/year) where the liquid was removed from the shell and given a very slight heat process. Industrial experience and belief was that going to any higher pasteurization treatments would coagulate the egg in the heat exchanger. This minimum treatment would only give the eggs a refrigerated shelf life of only 10-14 days, at best. Thus, the industry froze the liquid eggs in 30 lb tins. The user (large restaurants) would anticipate their needs and sit the tins out the night before. The outside rings thawed quickly and created a health issue while condensation accumulated on the floor and the center was still frozen in the morning. My graduate student and I saw this as an opportunity. With all the research done on eggs over the previous 40 years, no information existed on what it took to coagulate an egg. My graduate student, Mo Samimi, spent two years of his graduate research time in the lab understanding the rheology of heating liquid eggs and correlating how well the product functioned (maximum pathogen destruction and minimum protein and functional loss). This product understanding was then incorporated into a previously developed novel thermal evaluation technique for heat exchangers, again developed from our lab. The result was a product process that we believed would yield a very long shelf life at refrigerated temperatures. Pilot scale work yielded even better results than we had predicted. A former student who had worked with Hershall Ball told us we needed to patent the concept- really! Patent a process for processing eggs! That was truly novel. Most faculty members have no idea that there work, although new and novel is really something we should patent. It was always publish or perish, not patent or perish.

The Taste of Commercialization!

Four patents came from that work and the process soon became commercial to a small boiled egg operation in Richfield, North Carolina (Morning Glory Egg Co.). They had not gotten into breaking eggs but were fascinated by the opportunity. They started one line and hired Mo to direct the operation. Their success drew attention from around the world. It was not long before they were bought out by Michael Foods, Inc. out of Minneapolis. A new mega plant was going to be built. North Carolina was under strong consideration but the economic incentives were not there. A perceived low technology agriculture product processing plant gave no excitement to a state focused on biotechnology, microelectronics and the film industry. They saw millions of laying hens adding to the waste problem compounded by the already huge fryer, turkey and growing pork industries. The time was not right for North Carolina. We had become centered on non-polluting industries. The plant was ultimately built in Minnesota. Today Michael Foods, Inc. has plants in several countries and employ nearly 5,000. In 1994 they along with the university jointly received the IFT Industrial Achievement Award.
**Intersection of academic research and the world of attorneys**

My true baptism into the “real” world was that of high dollar lawyers and all the legal aspects of protecting intellectual property. As I was told, only successful technologies are infringed and patents are only worth what is invested to defend them. At one time we had eight active lawsuits for infringement. We won all cases and case actions except the last one. Up to that point all cases were won in court, settled or bought out by our licensee. After 17 years of paying royalties to the university they went up against a true mega company-26 lawyers on staff looking for something to do. In a previous case, that we won my world was shaken. I had always believed that faculties are the salt of the earth.

**Faculty Integrity**

I was a witness to a distinguished professor going on the stand in a federal court and blatantly lying. It is a matter of court record. Faculties are not always the salt of the earth. As a young graduate student and now a faculty member myself, I had always believed faculty were of the highest integrity. I had worked in industry and saw many examples of not exactly being on the up and up. In my first industry job at the age of 21 in Kenosha, Wisconsin I turned in my very first expense report. Within just a few minutes the director of the project engineers called me in. Oh my gosh-I had done everything possible to have my report exactly right. His exact words were “What is this?” I was in shock and speechless. He stated “No one can eat for this amount for dinner!” Again, I was speechless. But I was thinking that was what I spent-the penny. He stood and leaned over his desk and said: “You are going to ruin it for all of us. I don’t ever want to see another expense report with a dinner less than $X.” He went on to explain that we are not paid extra for the overtime and the travel time. This is the only way we can help compensate in a small way. “Well, this was industry and I wanted to play the game-so I did. However, working in a great land-grant institution was all together different. Faculty values were different. Money was never the driving force. Seeing an idea becomes real and increasing the quality of life was the real value-right? We were role models or at least working hard to become one. A named distinguished professor was beyond reproach. However, now I am in court cases. In this environment I learned that in the very place where truth and honesty should stand highest there were sinkholes! In my very first case I witnessed a distinguished professor lying on the stand. Why? I never knew, but my respect and faculty value system were clearly shaken. Years later we were going up against a giant food company with unlimited deep pockets. Through depositions and one colleague on the stand, untruths and data manipulation flowed like honey. These were my colleagues! These were people I had worked with and had tremendous respect. What were they doing? In life, especially in academics, one’s good name is all one really has. One spends a lifetime to develop the good name and to tear it down—for what? Two of these had been presidents of “The” major food professional society in the US. Did the deep pockets get to them? I will never know. Even the Federal judge made fun of calculations I did on the white board. Would this be the basis for dismissing himself-it never happened but he certainly played a role in influencing the jury in the hometown of the mega company? Throughout all the cases I gave 21 days of depositions, over 5 days total on the stand in different federal courts. I have always done what was right. Several times I have been asked to be an expert witness
to a court case. I have always either been dismissed or I dismissed myself. If I cannot believe in the cause and know down deep that the position is right, I will not be a party to it.

**Science for hire**

In 1994, the local newspaper decided that faculty at Duke, University of North Carolina-Chapel Hill (UNC-CH) and North Carolina State were lining their pockets using their positions and university resources. Stories came out about a professor at Duke that had purchased an expensive house. Another professor at UNC-CH had spent a sizable amount of gift funds entertaining agents from funding institutions and industry. I was highlighted for putting 86 people out of work in Richfield, NC. In any cases the true story was never told. The millions of dollars flowing into Duke from this professor’s inventions were overlooked. The $26 million of grants for one year from the UNC-CH professor was overlooked. Yes, 86 people in Richfield did lose their jobs in the egg industry. However, the two brothers that sold out and became multi-millionaires started several businesses and all 86 plus many more were hired back in theses companies. It actually produced an economic boost for the region. Nevertheless these non-conventional faculties were targets and theses stories were going to sell papers. The only problem was that no one cared. The public saw this as ROI, which today is an expectation!

Yes, universities share their royalty income with the inventors. As a side note royalties received by the university are not royalties to the inventors. Universities want desperately to list those payments under royalties on the 1099s. In reality they are long-term capital gain installment payments. I spent a great deal of time and dollars to uncover that little fact. However, universities still refuse to believe the opinion from multiple IP tax attorneys. Oh well, we have our traditions. In fact, just prior to going off to yet another court appearance I thought I should inform my Dean of my activities (I was asked to be there as the official university representative in addition to being an expert witness). The short meeting went well until I was walking out of the office. Many administrators must have the last word. The line that pieced my back was” If we didn’t have patents, we would not have patent infringement lawsuits. If we didn’t have patent infringement lawsuits, faculty could get back to doing what they were hired to do.” Ouch!

For my entire professional life I have been captivated with processing product with particles during continuous flow-stews, soups, beans-anything with particles. These were my crafts moving through a fluid-they were flying! It was not that it couldn’t be done; many extremely creative people have devised all sorts of innovated equipment to make it happen all over the world. However, in most cases it never caught on because the product quality was no better than with traditional canned product. In the United States a much steeper barrier existed--The Food and Drug Administration (FDA). All low acid foods (ph>4.5) processes must be filed and a “no rejection” letter received before legal processing can happen. This is true for any product brought in from other countries and sold in the US. To validate the fastest moving particle, in the largest particle with the poorest heat transfer properties (worst case) has been a difficult problem to solve. After many graduate students and post-docs, several patents and much frustration a unique set of tools have been developed. Much due to Josip Simunovic, who started out in my lab as a Ph.D. student, moved to post-doc and is now a Research Full Professor. This
industry challenge bit him and for years we have worked together to provide industry with technology we believe will increase quality of life for all of us. During this time, as a sideline project, volumetric microwave heating became part of our research. From that a technology with many players, created a way to utilize the surplus supply of sweet potatoes. Each year 25-30 % of the immense crop in North Carolina was plowed back into the ground because they were misshapen and not suitable for the fresh market. The new technology provided a way to render a sweet potato puree shelf stable in 300-gallon totes. Suddenly, baby food companies, bakeries and soup and vegetable juice companies had a reliable, highly nutritious, all natural, uniform and convenient supply of very nutritious, close to fresh in appearance and aroma, ingredient. Sweet potato farmers (not processors) invested and built the first ever volumetric microwave heated FDA no-rejection letter processing plant, again in North Carolina (Snowhill)-YAMCO. Again, in 2009 The University was awarded the IFT Industrial Achievement Award. This has been an industry boost and an economic development plant for rural North Carolina.

In the meantime, the tools for two-phase process validation provided an avenue to another start-up company-Ultraseptics. Josip and I, inside the university, and one businessman, from outside the university, became the founders. For almost four years Ultraseptics existed without outside investment, making enough to exist while the founders all had day jobs. Our business partner wanted to grow. He wanted a restructuring. Thermalysts was formed to focus exclusively on the validation tools, while Ultraseptics , the parent company, would continue to do consulting, technology development and workshops. The university demonstrating patience now decided to inform the two partners working for the university that they had to fish or cut bait. Step down as officers of the company or leave the university. As it is understood this was the same offer other entrepreneur colleagues have been given. Being forced out of the university worked well for some financially, even if it may not have been the best for the university or for what each founder wanted at the time. In our case, we selected to stay with the university. Our businessperson became the CEO. Immediately, he worked to leave his day job by raising capital for the business. Through the process a sub-license was granted to an individual who was not in processing. However, he hired our businessperson and one of his colleagues to work for him in his venture and start-up company-Empire Foods. This arrangement came about after an attempt to raise capital and build a co-packing operation in Farmville, NC failed. After 1-½ years the arrangement with Empire Foods stagnated. Ultraseptics became Aseptia, Inc.; a co-packing operation (Wright Foods, Inc.) was developed in Troy, NC with the grand opening in August 2012. The plant at one time employed 120 individuals. In July of 2013 Governor Pat McCrory announced the company planned to expand to reach 500 employees within 5 years. However, due to over reach, and continued rising debt the plant and sister dairy plant owned by Aseptia was sold to AmeriQual, a newly formed subsidiary of Indiana-based AmeriQual Group Holdings-and so it goes!

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