# Generational Perspectives and the Impact on Engineering Education

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## Summary

Engineering is governed by linear time; conversely, historical authors view modern cyclic time as four turning modes repeating about every 90 years. Currently, the nation is just beginning the fourth turning of the Millennial Saeculum. For higher education, a new generation, the Millennial, reached eighteen and began college in the fall of 2000. This new generation of students is the first of some twenty years of overall good, well-behaved, increasingly dedicated students that will be ready to learn and prudently accept responsible positions in society. Are the Colleges of Engineering ready? [1,2]

## Generations Theory

The concept of linear time has influenced western society paradigms for centuries. Linear time (for example, one month or one year) lays a basis for accepting change as a progressive concept. Generation's theory does not replace linear time but superimposes the concept of cyclic time. The imposition of cyclic time over linear time produces generational fluctuations as society progresses over linear time. The historical generational fluctuations described here are not the same as family generations.

The theory of historical generations is a study of time repetitions of basic social stresses over a current 90-year cycle. Each cycle normally has four types of generations; each cycle has four turning slightly out of phase with generational changes. [3] Historians Strauss and Howe employ the generational types of Idealist, Reactive, Civic, and Adaptive. These historical generations follow each other and average 22 – 23 years in length. The 90-year cycle (or to use the Latin word, saeculum [2]) extends back several centuries.

The characteristics of the four generations theory types are: [2,3]

- An *Idealist* generation grows up as increasingly indulged post-Crisis children, comes of age as the narcissistic young crusaders of an Awakening, cultivates principle as moralistic mid-lifers, and emerges as wise elders guiding the next Crisis.
- A *Reactive* generation grows up as under-protected children during an Awakening, comes of age as the alienated young adults of a post-Awakening world, mellows into pragmatic mid-life leaders during a Crisis, and ages into tough post-Crisis elders.
- A *Civic* generation grows up as increasingly protected post-Awakening children, comes of age as the heroic young team workers of a Crisis, demonstrates hubris as energetic mid-lifers, and emerges as powerful elders attacked by the next Awakening.
- An *Adaptive* generation grows up as overprotected children during a Crisis, comes of age as the sensitive young adults of a post-Crisis world, breaks free as indecisive mid-life leaders during an Awakening, and ages into empathic post-Awakening elders.

The common media names for the currently living generations starting with the youngest are:

- Millennial (Y) - Civic type with birth years of 1982 – 2003?;
- X - Reactive type with birth years of 1961 – 1981;
- Boomer - Idealist type with birth years of 1943 – 1960;
- Silent - Adaptive type with birth years of 1925 – 1942;
- GI - Civic type with birth years of 1901 – 1924.

These characteristics use the turning terminology of Awakening and Crisis and are: [2,3]

- The First Turning is a High – an upbeat era of strengthening institutions and weakening individualism, when a new civic order implants and the old values regime decays. The Reactive enter elder-hood; Civic, midlife; Adaptive, young adulthood; and Reactive, childhood.
- The Second Turning is an Awakening – a passionate era of spiritual upheaval when civic order comes under attack from a new values regime. The Civic enter elder-hood; Adaptive, midlife; Idealist, young adulthood; and, Reactive, childhood.
- The Third Turning is an Unraveling – a downcast era of strengthening individualism and weakening institutions, when the old civic order decays and the new values regime implants. The Adaptive enter elder-hood; Idealist, midlife; Reactive, young adulthood; and, Civic, childhood.
- The Fourth Turning is a Crisis – a decisive era of secular upheaval, when the values regime propels the replacement of the old civic order with a new one. Idealist enter elder-hood; Reactive, midline; Civic, young adulthood; and Adaptive, childhood.

Generational theory uses the concept of "turning" as generations replace each other. It predicts two high societal stress times. The first stress time occurs in the Second Turning as an Awakening, and occurred in modern times in 1960 - 70. The second stress time occurs in the Fourth Turning and represents a Crisis and last occurred in 1930 - 40. The next Crisis is predicted for the time period of 2020+. Historians infer that a Fourth Turning Crisis is not triggered by unusual events; thus, the alignment of generations causes the Crisis.

The inclusive dates of the Nation's last turnings are:

- First Turning, 1946 – 1963;
- Second Turning, 1964 – 1983;
- Third Turning, 1984 – 2004?;
- Fourth Turning, 1929 – 1945.

Thus, the Third Turning is ending and a new Fourth Turning will be (is?) starting in the near future (Figure 1).

**Balancing Freedom with Responsibility**

Consider a horizontal line as a continuum. Define the right endpoint as chaos, the left as total control. The workings of the United States government (freedom and equality) can be associated with this continuum; total freedom approaches chaos (anarchy) and perfect equality approaches total control (totalitarianism). Democracy is dynamic and the balance between chaos and control depends upon the makeup of society at any one time. As generations change society, they also change the location of democracy on the continuum. The position of democracy over a saeculum will ideally look like the tracing of a sine curve (Figure 2). The First Turning is described with strong government, the Second Turning (Awakening) shifts rapidly toward individualism.

Individualism maximizes with the Third Turning (Crisis results), and government reestablishes more control in the Fourth Turning to overcome the Crisis.

**Trends in Engineering Education**

Since each of the four generations of a saeculum has distinct characteristics, engineering education also cycles. Faculty members generally represent two generations while students are often a third. Generational stresses between faculty and students are not uncommon, and the alignment of such generations has an impact on engineering education.

The difference in generations affects the numbers enrolled in and graduating from engineering. The Reactive (X generation) are the most right-brained followed by Idealists (Boomers). Engineering is a left-brained profession and right-brained generations likely have smaller percentages adequately prepared for engineering by grades K – 12; however, engineering education is not static and adjusts over time – perhaps adversely – to this change.

In the past four decades, enrollment statistics show some interesting trends related to generational theory. [2,4] Consider the number of engineering graduates per million population (Table 1). [4] Enrollments peaked in 1984 and then declined for over a decade. In terms of generations, the last of the Boomers (Idealists), likely graduated in 1982 – 84. A transition between the Boomer and X (Reactive) Generations occurred about this time period. Evidently, the last wave of the Boomer Generation was ripe for engineering. Conversely, the first wave of the X Generation either did not customarily enroll in engineering or fell by the wayside in increasingly large numbers, or both. A further aspect may be that the engineering educational standards were also relaxed in that decade, so the impact on the engineering profession was potentially larger than these numbers indicate.

Currently, the transition between the X (Reactive) and Millennial (Civic) Generations is occurring, because the first Millennial persons turned eighteen in 2000. (Howe and Strauss prefer the term "Millennial" over "Y". [5, p.6]) Therefore, the prediction is that the number of engineering graduates will again start climbing given that the Millennial Generation is of the Civic type and possess strong potential engineering credentials (community oriented, scientifically inclined, good learners, team players, modest, and willing to take directions from parents and teachers.)

Millennials will prefer a more structured curriculum with ways to measure objective progress. Boomers enjoyed school but battled the rules and behaved in a less controlled manner as the rules were relaxed. Millennials say they dislike school but are better behaved, as the rules become stricter [5,6]. Millennials are showing progressively better performance in school contrasted with boomer performance that declined in the 1960's. Millennial parents are also more active in their children's education and are likely to be more involved in Millennial college years.

**Engineering Faculty**

The active faculty composing an engineering college contains three generations of persons from age 28 upwards. In 2002, the X Generation (Reactive) is between 21 and 41, the Boomer (Idealist) between 42 and 60, and the Silent (Adaptive) over 60. The immediate question is if this wide variation in generational attributes leads to faculty unrest and possible discord?

In engineering, this is doubtful at the baccalaureate level of instruction since the curriculum is well planned and only modest change occurs between faculty members. However, as faculty implement changes to ABET and seek to streamline curricula, generational conflict is likely to occur. The greatest difference might exist in the capstone design courses as various members of the faculty often emphasize different design aspects. For instance, Civic and Adaptive Generations will stress design analysis, while Idealist and Reactive Generations may accentuate design synthesis. In the current situation with X (Reactive) and Boomer (Idealist) Generations as faculty, this is unlikely to become a problem. However, as the Millennial Generation (Civic) begins to phase into the faculty in 10 years, this is potentially a more serious situation.

Ideally, engineering instruction should be tuned to the students' brain attributes. The current faculty approach to teaching engineering is to follow the traditional path of students first mastering the fundamentals of mathematics, physics, chemistry, etc. Then students are taught fundamental engineering science applications stressing applied mathematics before finishing with integrated aspects involving advanced analysis and design. This type of education is highly left-brained and two of the four generations (GI/Civic and Silent/Adaptive) preferred this approach to learning. (Millennials are likely to be more left-brained at the very time that right-brained changes are being made to engineering curricula.)

Conversely, a more right-brained, holistic approach is to attack modest problems early in the educational process, and as situations arise requiring additional knowledge, a detour occurs to find the needed information. In this type of education, a professional becomes not a large reservoir of cognitive knowledge, but more of a reference for recognizing what information (but not necessarily knowledge) is needed and where to find it in this modern era of information overload. Currently, society is at a midpoint in generations of this type (X and Boomer).

"This intersection of life and time cannot be stopped. When it occurs, it will please some older people and displease others. On the brink of old age, Boomers will be delighted to see such civic-spirited young adults, but will despair at their disregard for the inner life. On the brink of mid-life, many Gen Xers will welcome the good example young adults will be setting for the next child generation, but will complain about the blandness of their groupthink." [5, page 364.]

The challenge to faculty will be not only to understand self, but also to understand and apply appropriate learning methodologies. Engineering faculty will also need to understand the "learning organization" and the impact of cultural/organizational change theory.

**Summary**

The authors hope to create a vivid interest in first observing – a good engineering trait – then proactively planning for the attributes of generations as they come and go in the nation's society. The first step is observation since a generational change is occurring in engineering education. The X Generation (Reactive) is phasing out of the baccalaureate program and the Millennial (Y) Generation (Civic) is phasing in for the next 20 years. The direction of the change enhances the traditional qualities of engineering education, so it is expected to be quite favorable. However, on the down side, the Millennial Generation (Civic) will likely scholastically challenge the faculty to a much higher degree than did the previous X (Reactive) Generation. The engineering faculty will work harder!

One plausible change is the increase in the graduation rate of the Millennial Generation from the traditional 50 percent to perhaps 60 – 70 percent. This should occur without lowering standards and may result in the raising of standards. Another change will be in the types of extension and outreach programs aimed at the continuing education of those in industry – especially as generations transform from phase to phase.

Educators are encouraged to learn more about Generational Theory [3,5,6]. This will likely improve interactions within faculty meetings, between faculty and students, and create better understanding in the interactions between educators and those in industry.

**Figure 1: Generational Age Location in History [1,3].**

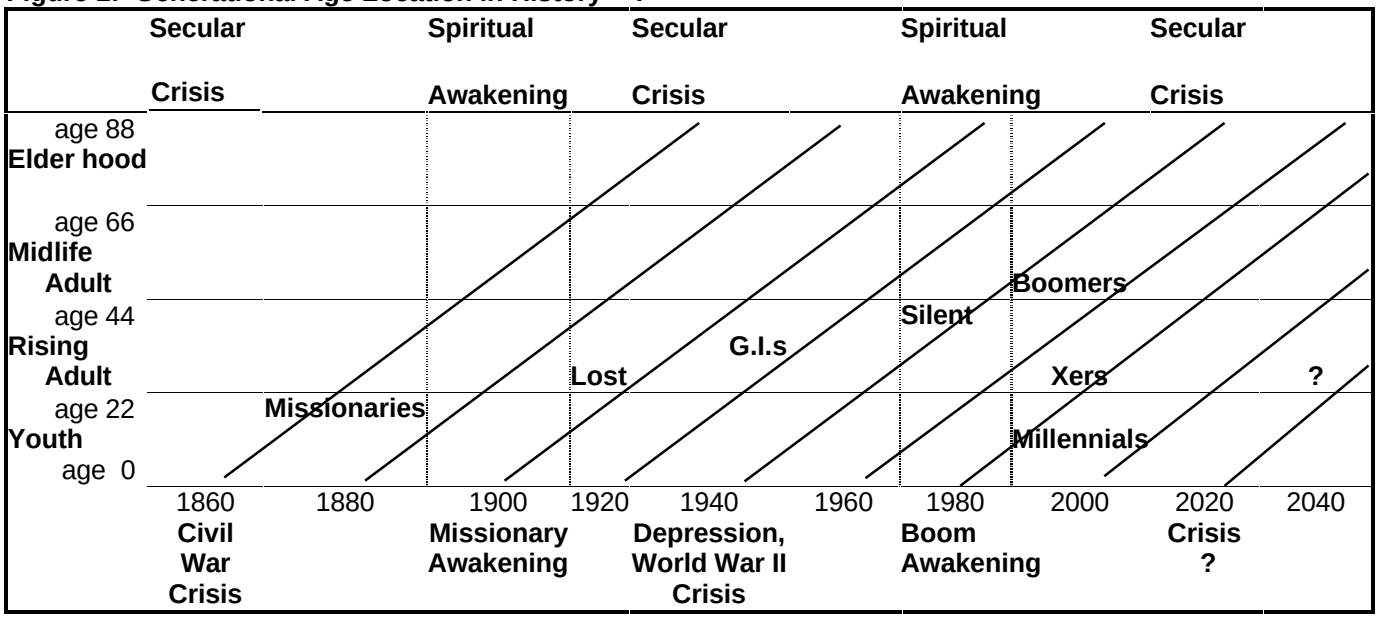


**Figure 2: The position of democracy over a saeculum.**

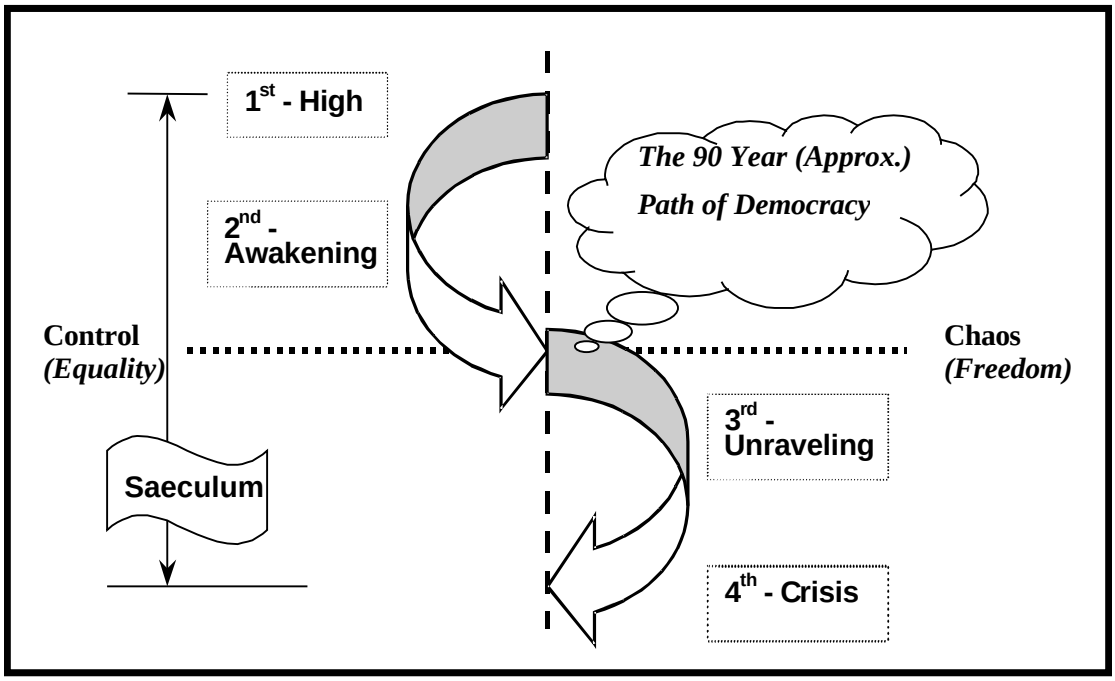

**Table 1: Number of engineering graduates per million populations [2,4].**

| # of Grads | 183 | 222 | 244 | 239 | 216 | 252 | 305 | 347 | 400 | 399 | 362 | 325 | 303 | 290 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | 1963 | 1970 | 1972 | 1974 | 1976 | 1978 | 1980 | 1982 | 1984 | 1986 | 1988 | 1990 | 1994 | 1996 |

## References


1. Mingle, John O., Roberts, Tom C., Generational Perspectives for Engineering Education, Kansas State University, March 7 – 9, 2001 Midwest Section Annual Meeting Proceedings.
2. Mingle, John O., Generational Perspectives for Engineering Education, Professor Emeritus, Kansas State University, P.O. Box 1311, Laramie WY 82072.
3. Strauss, W. and Howe, N., The Fourth Turning: What the Cycles of History Tell Us About America's Next Rendezvous with Destiny, Broadway Books, NY, 1997, ISBN 0-553-06682-X.
4. Statistical Abstract of the United States, various years, statistics include not only engineering graduates but also engineering technology graduates.
5. Strauss, W. and Howe, N., Millennials Rising: The Next Great Generation, Vintage Books, NY, 2000, ISBN 0-375-70719-0.
6. Raines, Clair., Generations: A Newsletter for Managers, Issue Six, 222 Milwaukee, Suite 200, Denver, CO 80206.



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