

Tom Edgar: teacher, department chair, consortium
founder, research colleague, friend

James B. Rawlings

Department of Chemical Engineering



TFE Career Celebration
26 August 2022
Austin, Texas

Outline

- 1 Tom as an undergraduate instructor
- 2 Tom as a department chair
- 3 Tom as a director of an industrial consortium
- 4 The Big picture, what is a university career

A selective look at Tom's vita

THOMAS F. EDGAR

Department of Chemical Engineering
University of Texas, Austin, Texas 78712
(512) 471-3080

September 1, 2020

PERSONAL

Date of birth: April 17, 1945

Place of birth: Bartlesville, Oklahoma

EDUCATION

Princeton University, Ph.D., Chemical Engineering, 1971

Princeton University, M.A., Chemical Engineering, 1968

University of Kansas, B.S., Chemical Engineering, 1967

EMPLOYMENT

1968-1969	Process Engineer, Continental Oil Company, Baltimore, Maryland
1971-1976	Assistant Professor of Engineering, The University of Texas at Austin, Austin, Texas
1976-1981	Associate Professor of Chemical Engineering
1978 (Spring)	Visiting Professor of Chemical Engineering, University of California at Berkeley, Berkeley, CA
1979-1985	Graduate Advisor
1981-1985	Professor of Chemical Engineering
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WTF?
Industrial
Experience?!

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- Tom carried on in this less than ideal environment and finished his lecture
- And we couldn't wait to get back in the classroom

I joined Tom's group as an undergraduate researcher

Ph.D. Dissertations

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- [2] L. S. Tung, 8/79, Analysis and Control of Large Scale Processes with Limited Measurements.
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- I wanted to get a faculty job before people found out about this deal!

As a faculty colleague—My final paper with Tom

- [76] R.S.H. Mah, G.V. Reklaitis, D. M. Himmelblau, and T.F. Edgar. Computer Aids in Chemical Education. *ChemTech*, Vol. 18, pp. 277-283, 1988.
- [77] A.W. Alsop and T.F. Edgar. Nonlinear Heat Exchange Control Through the Use of Partially Linearized Control Variables. *Chem. Engr. Commun.*, Vol. 75, pp. 155-170, 1989.
- [78] B.W. Bequette and T.F. Edgar. Non-interacting Control System Design Methods in Distillation. *Comp. Chem. Engr.*, Vol. 13(6), pp. 641-650, 1989.
- [79] T. Setalvad, I. Trachtenberg, B. W. Bequette, and T.F. Edgar. Optimization of a Low Pressure CVD Reactor for the Deposition of Thin Films. *IEC Res.*, Vol. 28, pp. 1162-1170, 1989.
- [80] S. Venkatesan, I. Trachtenberg, and T.F. Edgar. On the Dynamics of an Isothermal Radial-Flow Plasma Etcher. *J. Electrochem. Soc.*, Vol. 136(9), pp. 2532-2545, 1989.
- [81] A. Patwardhan, J. B. Rawlings, and T.F. Edgar. Nonlinear Model Predictive Control Using Simultaneous Solution and Optimization. *Chem. Engr. Commun.*, Vol. 87, pp. 123-141, 1990.

But wait, what's this other Rawlings paper?

- [283] J.D. Hedengren, R.A. Shishavan, K.M. Powell, and T.F. Edgar. (2014). “Nonlinear Modeling, Estimation and Predictive Control in APMonitor.” *Computers and Chemical Engineering*, 70, 133-148. doi:10.1016/j.compchemeng.2014.04.013
- [284] D. Castineira, B.C. Rawlings, and T.F. Edgar. (2012). “Multivariate Image Analysis (MIA) for Industrial Flare Combustion Control.” *IEC Research*, 51(39), 12642-12652. <http://dx.doi.org/10.1021/ie3003039>
- [285] W.J. Cole, D.P. Morton, and T.F. Edgar. (2014). “Optimal Electricity Rate Structures for Peak Demand Reduction Using Economic Model Predictive Control.” *J. Proc. Cont.*, 28(8), 1311-1317. <http://dx.doi.org/10.1016/j.jprocont.2014.04.014>
- [286] R. Wang, M. Nixon, W. Wojsznis, R. Dunia, T.F. Edgar, and M. Baldea. “A Geometric Framework for Detection and Classification of Abnormal Events and Systemic Faults in Process Systems.” *J. Proc. Cont.*. Accepted, 2014.
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- Tom's influence extends over *generations* in some families

And where does this madness end?

- [345] L. Yan, T.F. Edgar, and M. Baldea (2019). “Dynamic Process Intensification of Binary Distillation Based on Output Multiplicity.” *AIChE J.*, 65(4), 1162-1172.
- [346] J. Lee, S.W. Sung, F.Y. Lee, T.F. Edgar, and M. Baldea (2019). “Full Closed-loop Tests for the Relay Feedback Autotuning of Stable, Integrating and Unstable Processes.” *ACS Omega*, submitted.
- [347] H.S. Ganesh, D.P. Dean, S. Vernuccio, T.F. Edgar, M. Baldea, L.J. Broadbelt, M.A. Stadtherr, and D.T. Allen (2020). “Product Value Modeling for a Natural Gas Liquid to Liquid Transportation Fuel Process.” *IEC Research*. <https://dx.doi.org/10.1021/acs.iecr.9b06673>
- [348] T.F. Edgar (2020). “Methods of Weighted Moments for the Relay Feedback Autotuning of Conservative PI Controllers.” *Comp. and Chem. Eng.*
- [349] J. Lee, M. Baldea, T.F. Edgar (2020). “Shape Factor for the Relay Feedback Autotuning.” *Indian Chemical Engineer*, submitted 3.2020.

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To say the things he truly feels
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The record shows I took the blows
And did it my way

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My Way, English lyrics by Paul Anka
Performed by Frank Sinatra, 1969

For those of you who don't know the song



Texas Modeling and Control Consortium
(TMCC)

3/5/93

Department of Chemical Engineering
University of Texas at Austin

Principal Investigators

- T.F. Edgar
- D.M. Himmelblau
- J.B. Rawlings
- I. Trachtenberg

23 graduate students, 2 postdocs

The organizational meeting, 1993

Chemical and Petroleum Engineering Building – CPE 2.222

March 5, 1993

8:45 a.m.	Coffee and Doughnuts	
9:00	TMCC Overview	T. Edgar
9:30	Nonlinear Model Predictive Control (NMPC)	J. Rawlings
10:00	Batch Distillation Modeling and Control (lab tour)	J. Bosley
10:30	Break	
10:45	Crystallizer Control (NMPC)	S. Miller
11:15	Octave Modeling Project	J. Eaton
11:30	New Developments in NMPC	S. Meadows
12:00	Lunch – Faculty Center – Room 203	
1:30 p.m.	Artificial Neural Nets in Modeling and Control	D. Himmelblau
2:00	Gross Error Detection with Neural Nets	T. Karjala
2:20	Fuzzy Heuristic Control Algorithms	C. Ling
2:40	Overview of Advanced Control in Microelectronics Processing	I. Trachtenberg
3:00	Break	
3:15	Modeling and Control of a CVD Reactor	S. Chatterjee
3:40	Discussion of Consortium Operations	T. Edgar
4:30	Adjourn	

The Twenty year celebration meeting



Major Events Since 1993

- TMCC → TWMCC (JBR → UW) → TWCCC (JQ → USC)
- Meetings alternate between three locations
- Spring meeting length increased (1 day → 1.5 or 2 days)
- Technical information available over the web
- On-line presentations available at meeting (*we went green*)
- Sponsors range from 10 (1993) to 20 (1998) to 13 (2013) (30 + different companies), merging of some sponsors
- Some sponsors now support more than one PI/student
- More local internships (students perform Ph.D. work off-campus)
- Since 1993, over 100 Ph.D.'s graduated while involved with the consortium.

The TFE, JBR, Joe Qin, Michael Baldea chain of Pls



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Tom trained all three of us!

TWMCC News (2003)

- Joe Qin promoted to Professor (9/03)
- Industrial environment difficult, but may increase numbers of better Ph.D. students
- Jim Rawlings to “retire” from UW chair position (9/03), plans to return to productive work

History of Process Systems Research Consortia

- Chemical Modeling & Process Control Research Center, Lehigh University – *disbanded after G. Georgakis left*
- Neural Net Club (UMD / Newcastle) – *disbanded after T. McAvoy retired*
- Center for Process Analytical Chemistry, University of Washington – *privately supported, still going strong*
- McMaster Control Consortium – *shrunk after retirements of MacGregor and Marlin*
- Measurement and Control Engineering Center, University of Tennessee, Oklahoma State – *does not exist anymore (Google)*
- Texas Tech Process Control and Optimization Consortium – *small effort after departure of Riggs, Rhinehart, and Karim*

History of Process Systems Research Consortia

- UC Santa Barbara Consortium – *merged with U. Mass but then disbanded*
- University of Delaware Process Monitoring and Control Consortium – *did not last very long*
- Computer-Integrated Process Operations Consortium, Purdue – *morphed into NSF Center on Pharmaceutical Manufacturing with Rutgers and U. Puerto Rico*
- Center for Advanced Process Decision-Making, Carnegie Mellon – *thriving with Grossmann, Biegler, Ydstie, Siirola*
- Texas-Wisconsin-California Control Consortium (TWCCC) – *20 years of excellence*

Smart Manufacturing Update

- Smart Manufacturing Leadership Coalition (SMLC) formalized as 501(c)(6) business league (non-profit)
- \$7.8 million DoE proposal selected for funding but award delayed due to Congressional funding freeze (UT, UCLA, four computer vendors, Praxair, General Dynamics, AIChE, Nimbis)
- Oct. 2-3, 2012 SMLC Forum in Washington, D.C. began organizational effort, fund raising (industry, university, govt. lab membership)
- Membership: 8 companies, 9 universities, and 5 government labs

Tom Edgar's New Part-time Job

UNIVERSITY OF TEXAS

Veteran UT prof to lead Energy Institute

Congratulations!

By Asher Price

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University of Texas officials announced Tuesday that they have named a chemical engineering professor to serve as interim director of UT's **embattled** Energy Institute.



Chemical engineering professor Thomas Edgar sees himself as a 'facilitator'

Condolences!

The big picture—What did the University of Texas awaken in me

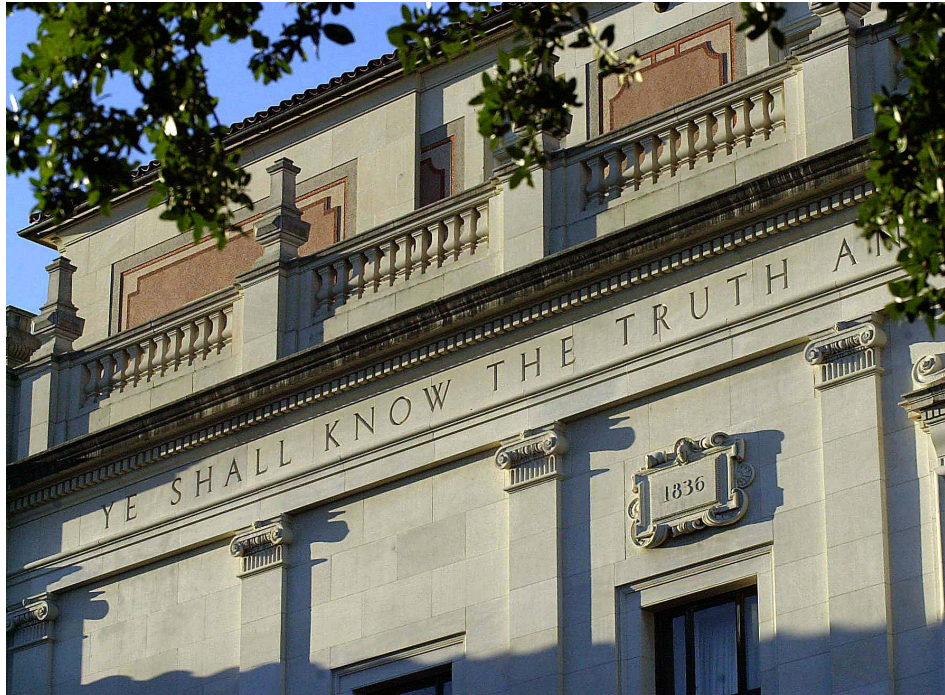
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The big picture—What did the University of Texas awaken in me

- I was a freshman living in the Jester dormitory in the fall of 1975
- My first time living on my own
- Every morning when I walked to class I saw the following inscription on the main building . . .





UT President W.J. Battle and that inscription

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- His greatest contribution, though, was to chair the Faculty Building Committee from 1920–1948.
- Battle's lifelong interest in architecture was almost as great as his fascination with Ancient Greece and Rome, and he took great care to ensure that the design of the campus and its buildings were both appropriate to their setting in Texas, and reflected the high aspirations of the University.

We almost didn't get that inscription

The building committee met May 20, 1935 to make a decision. Battle handed each member a sheet of paper with the choices, though from the wording he seemed to still be encouraging his initial creation. The page read:

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The page read:

W. J. Battle's suggestion for the Library front inscription:

The records of the past shall bring light and courage
to them that come after

Another suggestion:

Ye shall know the truth and the truth shall make you free

The main building at the University of Freiburg, Germany





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We set up *systems* to discover the truth in these different areas.
- And that's not easy. The *scientific method* is our great gift from the *enlightenment*.

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- And despite outward appearance and behavior, Tom is *sensitive*