Latency and Rent's Rule

Wilm E. Donath
IBM T. J. Watson Research Laboratory
Yorktown Heights, NY 10598

Rent's Rule relates the terminal count T of a logic complex to the number of gates C contained in the logic complex by the equation

$$T = AC^p \tag{1}$$

where A is a constant and p the Rent exponent, which has varied anywhere from 0.47 to 0.80. Equation 1 was used to estimate wiring space requirements; in spite of the large potential variability of the Rent exponent, it worked *reasonably well* with an exponent of 0.67 [3]. (I will tell the story of my personal involvement with wirability.) However, the basic uncertainty of this approach demands a better understanding of Rent's Rule, and the hierarchical model [1] will be described.

Latency will be discussed in terms of the hierarchical design model as well as the Feuer model and compared with the range of values obtained by the Donath-Hitchcock [2] studies: this comparison will suggest the direction of further studies.

The author believes that Rent's Rule is an incidental result of the design process of complex electronic circuits; large exponents are consistent with low latency and high performance circuits, while it is possible that there is a *sweet* spot for the rent exponent at 0.67.

References

[1] W. E. Donath. Equivalence of memory to random logic. *IBM Journal of Research and Development*, pages 401–407, September 1974.

[2] Wilm E. Donath and R. B. Hitchcock. Path lengths in combinational computer logic graphs. Report RC3383, IBM T. J. Watson Research Center, June 1974.

[3] W. R. Heller W. F. Mikhail and W. E. Donath. Prediction of wiring space requirements for lsi. In *Proceedings 7th Design Automation Workshop*, pages 32–42, June 1977.