

# VARIATION IN WORK IMPROVEMENT POTENTIAL FOR SMALL/MEDIUM CONTRACTORS

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## BACKGROUND

The annual dollar volume of the domestic construction industry is estimated to be approximately \$300 billion. Roughly one-third of this total volume is performed by the ENR (*Engineering News-Record*) Top 400 contractors ("The top 400" 1986). The rest is performed by an estimated 400,000–500,000 small to medium firms. In order to investigate whether smaller firms encounter the same productivity problems as the aforementioned, well-investigated ENR 400 group, a study was conducted in 1981 with the participation of small to medium contractors. The findings were published in the *Journal of Construction Engineering and Management* (Koehn and Caplan 1987). In general, the 1981 results indicate, as summarized in Tables 1–3, that functions exhibiting a high potential for productivity improvement include supervision, labor relations, planning, scheduling, and communications.

The present investigation, conducted in 1986, updates and complements the previous study and involves, for comparison purposes, firms from the same contracting organizations (Indiana Constructors, Ohio Contractors Association, and AGC of Indiana). Its purpose is to identify new trends and to study the change in perceptions of small to medium contractors during the five-year interval under consideration. In addition, it compares the findings with those obtained from an investigation of ENR Top 400 Contractors (Arditi 1985).

## FINDINGS

The comprehensive findings of the investigation are listed in Tables 1–3. Of the 359 survey forms distributed, 18% were returned, representing an annual construction volume of approximately \$1 billion. The questionnaire is identical to that used in the previous study and it appears in the report published in the *Journal of Construction Engineering and Management* (Koehn and Caplan 1987). The rate of response for small/medium contractors decreased between 1981 and 1986 from 24% to 18%. This may indicate an increase in productivity and/or a reduction in the level of concern of contractors regarding low productivity of construction operations.

The data in Table 1 show that, overall in 1986, 34% of the firms perceived that productivity was a substantial problem in the construction industry. This is a significant reduction since 1981, when a value of 52%

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**TABLE 1. Magnitude of Productivity Problem in Construction Industry**

Volume of construction contracts (in millions) (1)	1986/1981 Response (Percent)		
	Substantial (2)	Quite a bit (3)	Hardly at all (4)
<\$5	28/47 <sup>a</sup>	56/51	16/2 <sup>a</sup>
\$5-\$25	33/54 <sup>a</sup>	61/40 <sup>a</sup>	6/6
>\$25	38/72 <sup>a</sup>	54/28 <sup>a</sup>	8/0 <sup>b</sup>
Total responding	34/52 <sup>a</sup>	56/45	10/3 <sup>c</sup>

<sup>a</sup>.01 level of significance of difference between 1986 and 1981 studies.

<sup>b</sup>.05 level of significance of difference between 1986 and 1981 studies.

<sup>c</sup>.10 level of significance of difference between 1986 and 1981 studies.

was noted. These values suggest a possible improvement in productivity for small/medium contractors between 1981 and 1986. It may also indicate, however, that more highly motivated and productive contractors than nonproductive contractors responded to the investigation.

## ON-SITE FUNCTIONS

Table 2 examines the contractors' perception of various on-site functions with regard to their opportunity for possible productivity improvement. Site supervision (73%), labor relations (68%), and contract agreements (62%) were indicated as being strongly related to the productivity of construction operations. Significantly lower values, however, (48%, 41%, and 48%) were given in the 1983 survey of ENR 400 contractors (Table 2). This may suggest that larger contractors are better able to budget for staff assistance in these functions and, therefore, do not perceive them as problem areas.

Material delivery (59%) was also considered a high-potential item for productivity improvement by smaller contractors. The ENR 400 firms, however (Table 2), perceive that it has significantly lower potential (25%). This is possibly an indication of poorer planning strategies employed by smaller firms in ordering and storing materials. Nevertheless, for prefabrication and standardization, organizations with a volume less than \$5,000,000 indicated significantly lower potential (33%) than contractors with a volume above \$25,000,000 (62%).

It is noteworthy that smaller firms perceive significantly higher potential for productivity improvement in Equal Employment Opportunity (EEO) rules than larger organizations (44% versus 15%). Smaller firms, therefore, must experience more difficulty and/or competition in this area.

In the 1981 study, 40% of the firms indicated that Occupational Safety and Health Administration (OSHA) rules exhibit a high potential for productivity improvement; while in 1986, OSHA's potential for productivity improvement declined to 26% (Table 2). This is a significant difference and may indicate that the industry has accepted OSHA rules and regulations as a guide to standard operating procedures. Another explanation could be that the rules and regulations have been revised and may have become less burdensome to work with. It is noteworthy that there is

**TABLE 2. Potential of On-Site Functions with Respect to their Opportunity for Possible Productivity Improvement**

Function (1)	Contractor Response as Percentage and as Function of Volume (in millions)											
	High potential for productivity improvement						Medium potential for productivity improvement					
	1986 Data				1981 total	ENR 400 <sup>d</sup>	1986 Data				1981 total	ENR 400 <sup>d</sup>
	< \$5 (2)	\$5-\$25 (3)	> \$25 (4)	Total (5)	(6)	(7)	< \$5 (8)	\$5-\$25 (9)	> \$25 (10)	Total (11)	(12)	(13)
Management												
Labor relations	78	55	62	68 <sup>ab</sup>	51 <sup>b</sup>	41 <sup>a</sup>	19	40	15	24 <sup>b</sup>	39 <sup>b</sup>	28
Cost control	41	55	62	52	40	38	44	40	38	39	39	44
Supervision	67	75	85	73 <sup>a</sup>	62	48 <sup>a</sup>	30	20	15	24	32	29
Regulations												
EPA	33	25	23	27	34	23	30	35	15	32	31	35
OSHA	19	30	23	26 <sup>b</sup>	40 <sup>b</sup>	25	52	50	31	45	34	41
EEO	44 <sup>b</sup>	50	15 <sup>b</sup>	41 <sup>c</sup>	47	26 <sup>c</sup>	26	20	38	27	23	36
Materials												
Delivery	63	60	38	59 <sup>ac</sup>	46 <sup>c</sup>	25 <sup>a</sup>	26	30	46	29 <sup>a</sup>	35	51 <sup>a</sup>
Storage	19	25	15	18	12	15	44	30	23	33 <sup>bc</sup>	47 <sup>b</sup>	49 <sup>c</sup>
Packaging	11	5	15	9	6	7	41	30	23	32	30	39
Prefabrication	33 <sup>c</sup>	25	62 <sup>c</sup>	35	25	35	37	30	23	36	41	35
Standardization	33 <sup>c</sup>	20	62 <sup>c</sup>	38	41	36	30	45	15	30	36	41
Product availability	22	35	23	29	37	23	41	25	46	36	30	38
New products	7 <sup>c</sup>	10	31 <sup>c</sup>	12	16	20	33	45	15	35	38	44
Labor												
Contract agreements	59	60	62	62	52	48	26	20	38	26	35	28
Training	56	50	31	48	51	54	33	30	62	38	36	36
Quality control	26	15	15	23 <sup>b</sup>	36 <sup>b</sup>	43 <sup>b</sup>	56	65	62	59	47	47
Turnover	33	40	38	35	28	29	37	30	31	35	45	46
Availability	26	25	15	24	26	16	30	45	31	36	40	48
Engineering												
Design standards	41	25	23	32	36	31	44	65	62	56 <sup>c</sup>	43 <sup>c</sup>	44
Design improvements	44	35	31	36	36	44	33 <sup>c</sup>	40	62 <sup>c</sup>	45	42	36
Systems engineering	19	20	8	15 <sup>c</sup>	19	28 <sup>c</sup>	48	50	38	45	43	44
Standard specifications	44	30	23	36	34	31	30 <sup>b</sup>	60 <sup>b</sup>	38	39	34	46
Equipment												
Capacity	26	40	23	29 <sup>c</sup>	23	15 <sup>c</sup>	52	25	46	44	43	49
Simplicity	26	35	46	32	27	26	63 <sup>b</sup>	30	31 <sup>b</sup>	44	45	44
Maintenance	52	50	38	50 <sup>b</sup>	40	33 <sup>b</sup>	37	25	38	32 <sup>c</sup>	43	47 <sup>c</sup>
Utilization	48	50	31	42	40	39	44	25	62	44	38	43
Construction technology												
Pre-cast elements	11	30	31	20	30	28	78 <sup>a</sup>	40 <sup>a</sup>	62	60 <sup>a</sup>	39 <sup>a</sup>	50
Pre-assembled modules	7 <sup>a</sup>	20	46 <sup>a</sup>	18 <sup>bc</sup>	28 <sup>c</sup>	36 <sup>b</sup>	67 <sup>c</sup>	40 <sup>c</sup>	54	53 <sup>bc</sup>	40 <sup>c</sup>	35 <sup>b</sup>
Foreign developments	15	5	8	9	5	10	22	20	15	18 <sup>b</sup>	16	38 <sup>b</sup>

<sup>a</sup>.01 level of significance of difference between smaller and larger contractors and/or various studies.<sup>b</sup>.05 level of significance of difference between smaller and larger contractors and/or various studies.<sup>c</sup>.10 level of significance of difference between smaller and larger contractors and/or various studies.<sup>d</sup>Data from Arditi (1985).

not a significant difference between the perceptions of large and small firms in regard to OSHA.

Quality control for smaller firms was listed as having less potential in 1986 (23%) than in 1981 (36%). Nevertheless, ENR 400 organizations

**TABLE 3. Potential of Main-office Functions for Possible Productivity Improvement**

Function (1)	Contractor Response as Percentage and as Function of Volume (in millions)											
	High potential for productivity improvement						Medium potential for productivity improvement					
	1986 Data				1981 total (6)	ENR 400 <sup>d</sup> (7)	1986 Data				1981 total (12)	ENR 400 <sup>d</sup> (13)
	< \$5 (2)	\$5-\$25 (3)	> \$25 (4)	Total (5)			< \$5 (8)	\$5-\$25 (9)	> \$25 (10)	Total (11)		
Planning	63	50	38	53	56	48	26 <sup>c</sup>	50 <sup>c</sup>	46	39	31	41
Scheduling	63	45	46	53	49	41	30	45	31	36	33	46
Estimating	37	30	15	29	19	33	37	45	38	41 <sup>c</sup>	38	56 <sup>c</sup>
Communications	48	70 <sup>b</sup>	31 <sup>b</sup>	55	49	43	26	20	46	27 <sup>b</sup>	31	46 <sup>b</sup>
Marketing	11	20	31	17 <sup>a</sup>	15	38 <sup>a</sup>	33	35	15	32 <sup>c</sup>	21 <sup>c</sup>	33
Procurement	30	25	38	32 <sup>c</sup>	21 <sup>c</sup>	21	37	45	23	35	37	44
Drafting	15 <sup>c</sup>	15	0 <sup>c</sup>	11	8	10	44	30	23	33	34	39
Specifications	30	35	31	30 <sup>b</sup>	26	15 <sup>b</sup>	48	40	23	42	34	36
Engineering	19	35	23	26	29	26	56	40	54	50	43	39

<sup>a</sup>.01 level of significance of difference between smaller and larger contractors and/or various studies.

<sup>b</sup>.05 level of significance of difference between smaller and larger contractors and/or various studies.

<sup>c</sup>.10 level of significance of difference between smaller and larger contractors and/or various studies.

<sup>d</sup>Data from Arditi (1985).

perceive that quality control has significantly greater potential (43%). This difference may be due, in part, to the national attention given to the quality control problem.

Table 2 also shows that in the equipment category, maintenance (50%) and utilization (42%) have the highest potential for productivity improvement. The 1981 survey revealed similar priorities. Nevertheless, ENR 400 organizations exhibit significantly less concern with equipment capacity (15% versus 29%) and maintenance (33% versus 50%). The foregoing indicates that smaller firms appear to have more equipment problems than larger companies. Large firms, because of their size, are probably able to maintain and utilize equipment on a more efficient and optimum basis.

### MAIN-OFFICE FUNCTIONS

Table 3 depicts the small to medium contractor's perception of various main-office functions with respect to their opportunity for possible productivity improvement. Planning (53%), scheduling (53%), and communications (55%) were regarded as exhibiting high potential for productivity improvement. The value for communications is interesting, since one would expect that, for the main office, communications would be less of a problem in small to medium organizations.

Further examination of Table 3 illustrates that there is an increase in the percentage of firms (21% to 32%) who believe that there is a high potential for productivity improvement in procurement activities. Also, the ENR Top 400 contractors indicate a significantly higher potential (38% versus 17%) in the marketing area. This is most likely due to the recent trend of larger companies to increase their interest in the application of marketing principles. The small/medium contractors, however, have only indicated an increase in the medium productivity potential category for marketing functions.

### SUMMARY AND CONCLUSIONS

A review of the data indicates that there have been a number of changes between 1981 and 1986 in the perceptions of small to medium contractors

regarding productivity. For example, the firms that perceive that productivity is a substantial problem decreased from 52% to 34%. This is a significant variation, suggesting possible improvement in productivity during the five-year period under consideration. The change may be the result of productivity improvement programs initiated by construction firms. It could also be attributable, in part, to the slump in the construction industry, which is restricting the employment opportunities for poorly qualified tradesmen.

In addition, the findings indicate that the main-office function of procurement has become more important for productivity improvement during the last five years. Also, an increase in potential for the on-site functions of labor relations and material delivery was detected. However, a decrease was shown in the productivity improvement potential for OSHA and quality control.

During the 1981–1986 period, international contractors were increasing their share of the U. S. domestic and foreign construction market (Pinyan 1986). It is noteworthy, therefore, that the data in Table 2 notes a low potential for productivity improvement in foreign developments (9%). It appears reasonable to assume, however, that interest in foreign developments will increase if the domestic construction industry encounters continuing international competition.

The overall results of the study tend to indicate that productivity improvement efforts should be concentrated in the following management-related functions: planning, scheduling, site supervision, and labor. This suggests that a continuing effort by management is required in order to increase the productivity of construction operations.

## APPENDIX. REFERENCES

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