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# Disaster Restoration Professional Body of Knowledge

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ABSTRACT: Companies performing building disaster restoration services wish to position themselves to continue to create substantial value for their clients. Doing so demands that restoration professionals be well educated in pertinent subject matter. Professional certification procedures commonly examine the pertinent subject matter that a professional should know. The Restoration Industry Association (RIA) created the Certified Restorer® (CR) credential to meet this need in the industry that the organization serves. To help ensure that their certification process examines the correct topics, the RIA partnered with Purdue University researchers to survey industry members for their opinions about the importance of managerial and technical disaster restoration subjects. The 275 respondents rated these as the three most important of 29 subjects: safety and health; project cost estimating and control; and project organizational structure. Besides the importance of each topic, statistical analysis showed that professional certification type was the characteristic most frequently associated with significant differences in ratings of subject importance ($\alpha = 0.10$ level).

**Key Words:** Disaster Restoration, Reconstruction, Professional Body of Knowledge

## Introduction

The past generation has witnessed rapid evolution of building disaster restoration and reconstruction services within the U.S. construction industry. Managerial and technical complexities have grown as much or more than in other industries. Owners and their insurers seek professionals who can improve the timeliness and quality of services to restore buildings after water, fire, and smoke damage to structures and contents; upon hazardous materials release; or when biohazards spread. As with other subsectors of the construction industry, specialized knowledge is required to better serve owner-clients. More than just knowing the new, applied technologies, those who would manage disaster restoration work skillfully must understand the necessary administrative procedures and management techniques that leverage the technologies and adapt to other changing factors. A number of professional organizations play important roles in establishing standards of performance for restoration work and certifications for technical competence. One of those is the Restoration Industry Association (RIA).

The RIA created the Certified Restorer® (CR) credential more than 25 years ago to establish a minimum level of knowledge and experience that a reputable disaster restoration project professional should have (King, 2009). The existing CR program requires that a series of courses be completed, seven years of restoration experience be documented, and the prospective certificant's integrity be confirmed. The course contents include mostly technical but also managerial knowledge. A 450 question multiple choice, all-day examination requires a score of 80 percent to pass. Finally, the prospective CR

must determine a topic for a capstone report or research paper and submit the document less than a year after passing the examination.

As with any professional certification or licensure process, properly conceived verification of proficiency by examination, experience, or both is essential for the credential to be generally accepted by knowledgeable people as valid and useful. The RIA is reviewing CR subject matter and requirements to ensure a better educated pool of contractor personnel are available to provide higher quality disaster restoration services. Influential individuals can sometimes sway curricula to their preferences, but subject selection on a more objective, broader basis is usually preferred. Seeking to confirm the subject matter that the CR credentialing process should examine, the RIA and Purdue University partnered throughout 2009 to determine the professional restoration topics that are appropriately included in the CR body of knowledge (BoK), as one looks at least five years into the future.

## Research Methodology

One naturally expects that those who do disaster restoration work will know best how important the various topics are to their activities. The researchers determined that a survey questionnaire allowing restoration professionals to rank order the importance of relevant topics would likely be the best mechanism for obtaining pertinent data. Besides ranking topic importance, the questionnaire would include questions to elicit data for descriptive statistics about the respondents and their firms. This would give RIA insight into their membership while providing understanding of how company and individual characteristics might influence responses. RIA member firms tend to be better established and among the leading enterprises for their type of work, so the employees of those firms are credible to opine about topics for a prospective disaster restoration body of knowledge.

To the extent that significant differences in topic rankings exist among respondents of different educational, experiential, and company backgrounds, insights might be discerned about how those demographics generally influence their work priorities and perceptions. Statistically significant differences in ranking of topic importance among more than two demographic groups can best be discerned by analysis of variance (ANOVA) tests. Knowledge of relationships between respondent demographics and the statistics resulting from their differing perceptions of topic importance would perhaps offer the RIA insights about appropriate experience and educational backgrounds to require of CRs. Knowing which topics appear most important for practicing restoration professionals would also enable the RIA to efficiently focus its instructional efforts where ever most needed. It also seemed probable that topics considered more important should probably be tested more comprehensively in the CR examination.

The method of research allowed meaningful comparison of practitioner perceptions of the importance of 29 assorted restoration topics. The RIA and Purdue agreed that a comprehensive but manageable list of topics, each of which could be rated by

respondents for their opinions of its importance in years ahead, would be useful to determine what should be included in future CR instruction. Further, the list of topics rank-ordered by importance could help prioritize the instructional resources to be devoted to each topic. Also, the researchers wanted sufficient responses to be able to perform a reliable factor analysis of data to help aggregate topics into statistically-related groups, thus to objectively provide reasonable structure to the BoK. By rule-of-thumb factor analysis requires about 10 respondents for every variable, survey question, to be aggregated into fewer factors. The researchers considered alternatives by which to obtain the greatest response for proper statistical inferences. After discussion with RIA, the objectives and the resources available led to a web-based questionnaire survey that would be sent to all of their member enterprises. Assorted individuals in each enterprise would receive a message inviting them to participate and offer their demographic data and opinions of topic importance.

### *Survey Questionnaire Development*

Development of the list of BoK subjects whose importance would be rated by industry practitioners began with exchanges between the RIA staff and Purdue researchers about the scope of the investigation. Conference calls resulted in a shared plan of action and tentative schedule for the activities. The RIA staff and select restoration practitioners confirmed the usefulness of the personal demographic data included in the questionnaire. The respondent data was obtained from their answers to these questions:

1. Work type. In which activities of the restoration industry do you have at least one year of experience? (Select all that apply.)
2. Number of employees. How many people does your company employ? (Not including contractors.)
3. Work location. In what geographic region(s) do you have at least one year of restoration industry experience? (Select all that apply.)
4. Headquarters location. Where is the headquarters office of your employer?
5. Technical experience. How many years of predominantly technical experience do you have in the restoration industry? (Technical experience occurs when knowledge of restoration processes, methods, techniques, equipment, and administration are applied in order to restore a damaged facility to its pre-disaster condition.)
6. Management experience. How many years of predominantly management experience do you have in the restoration industry? (Management experience occurs when multiple subordinate field or office employees routinely report to the person.)
7. Field experience. How many years of predominantly field experience do you have in the restoration industry? (Field experience is defined to occur when working in some role at restoration and reconstruction project sites.)
8. Education level. What is your highest level of formal education?
9. Highest degree major. What is the subject matter of your highest earned degree? (Do not respond, if high school/GED in #8.)

10. Certification. From which certifying bodies have you earned one or more restoration related certificates? (Select all that apply.)

The researchers initially inferred possible CR topics from references provided by the RIA. A brainstorming session in collaboration with a third faculty member resulted in an array of subjects that was suitable for staffing with various practitioner associates of RIA and the university. The subjects disaggregated into what seemed to be technical and managerial groups. Before the trial survey was launched in early summer 2009, a draft instrument was staffed with a select array of nine industry associates whose comments resulted in improvements to the questionnaire. A Likert six-scale was deemed adequately sensitive for the study. The final array of subjects whose importance respondents assessed follows:

1. Project work planning and scheduling techniques and software.
2. Project cost estimating and cost control techniques and software.
3. Project organizational structure of restoration personnel and equipment—staffing, resources, relationships, and responsibilities for efficiency and effectiveness.
4. Building information modeling (BIM) applied to restoration.
5. Project financial management, including pricing, cash flow, and cost accounting.
6. Structural drying science: psychrometric chart and laws of thermodynamics.
7. Influence of building structural and mechanical characteristics and configurations, including the building envelope, on building response to disasters.
8. Methods, techniques, and equipment by which to restore and reconstruct building systems, including the building envelope, after disasters.
9. Written and oral communication processes, techniques, and formats required for project management.
10. Project delivery mechanisms.
11. Project contract terms, conditions, and common disputes.
12. Project legal issues other than contractual.
13. Meeting and negotiation techniques.
14. Psychology and sociology of losses and disasters.
15. Safety and health requirements and processes for restoration.
16. Quality control and assurance techniques for restoration.
17. Historical building and artifact restoration techniques.
18. Roles and concerns of restoration project stakeholders.
19. Household common and luxury contents restoration processes and techniques--including accountability, storage, and logistics. (Include clothing, floor coverings, furniture, electronic devices, appliances, and incidentals.)
20. Environmental protection requirements and processes for restoration.
21. Material procurement and logistical management techniques for restoration.
22. Government emergency management requirements, policies, and processes.

23. Chemical structure and behavior of commonly restored materials. (Include textiles, ceramics, and leather).
24. Construction, manufacture, and vulnerabilities of restored composites. (Include musical instruments, electronic devices, clocks, oil paintings).
25. Green building restoration techniques.
26. Project risk management techniques, e.g., insurance types and terms.
27. Project start-up, mobilization, and close-out requirements.
28. Marketing requirements and techniques for restoration firms.
29. Hazardous biological, radiological, and chemical material management.

A few subjects were so obviously an important part of a complete CR BoK, that taking time and space to specifically survey members about them was deemed extraneous. Those four topics were water loss restoration, fire and smoke restoration, mold remediation, and ethics. Although the membership was not queried about those specific subjects, one understood that details about them must be included in any CR BoK, in addition to whatever else would be determined from the survey.

RIA and Purdue agreed that, based on their previous experiences, an expected duration under 15-minutes would be appropriate to encourage sufficient survey completions (Antonius, 2003). The researchers desired to perform a factor analysis of subject ratings, and this required responses to number about 10 times the number of subjects whose importance was rated (Field, 2005). To remain within the desired time, only 10 demographic and 29 subject questions were included. The trial survey confirmed that respondents would probably finish within 15-minutes.

*Survey Questionnaire Administration*

The survey was launched in mid-summer and offered respondents 18 days in which to complete their evaluations. The researchers established a URL, which was generated by Qualtrics survey software for multiple respondents. The RIA website linked to the URL. The RIA staff sent 6,380 invitations to its members in mid-summer 2009. Their message included a brief statement of the purpose for the survey and the link to the web survey. RIA sent two reminders about the survey to members during the period it was open.

A total of 1,180 members opened the message about the survey, so this number constitutes the sample for the survey. One expects that those in this category had at least scanned the RIA message, and that it had not been ignored or automatically categorized as “junk” and deleted. Among the sample, 312 responded to the survey, and 275 of them completed the survey. The complete response rate was 23.3 percent, which is greater than 20 percent and statistically acceptable. Besides the survey data analysis, the (anonymous) Institutional Review Board ensured that survey procedures and controls would adequately protect the anonymity of the respondents, to ensure that their participation and responses would neither be identified nor find their financial standing, employability, or reputation at risk as a result of participating in the survey.

The trimmed response time mean, 10 minutes, was calculated by discarding the lower and higher 25 percent of the scores and taking the mean of the remaining durations. It was well within the 15-minute ceiling established by the researchers to reduce the risk of respondents deciding to not complete the survey.

## Statistical Tests and Analysis

The survey data set was collected and analyzed using the Statistics Package for the Social Sciences (SPSS). The data were studied on aggregate levels to understand the importance of each of the subjects listed for the BoK design and to correlate demographic characteristics of survey respondents with each of the 29 subjects.

Descriptive statistics were run to examine the overall response distribution and the dispersion of the distribution. The Kolmogorov–Smirnov test determined that the sample came from a population with an approximately normal distribution (Peng, 2004). That is, the responses for each of the 29 BoK subject questions all tended to cluster symmetrically around the mean score, which was based on the six-point Likert scale. Confirming response distribution normality was especially desirable for the planned ANOVA tests. Had the distributions of responses been markedly non-normal, then analysis by nonparametric statistical tests would be required (Keller and Warrack, 1997). Other descriptive statistics including frequencies, means, response totals, ranges, and standard deviations were studied to summarize the demographic data and the BoK subject data.

### *Respondent Demographics*

The data for demographics showed that the respondents were well-distributed in all technical groups including fire and smoke, water loss, microbial, carpet cleaning, and mold/air quality. Those experienced in water loss numbered 260, followed by 243 who have worked fire and smoke and 222 with microbial experience.

Respondents numbering 238 were generally evenly distributed among company size ranges of one to six, seven to 15, 16 to 30, and 31 to 100 employees. Only six worked for firms of 1,000 employees or more.

The continental United States was well represented among locations where respondents had worked at least one year, although somewhat fewer, 36, reported working a year or more in the south central region. Seven logged a year or more in Alaska or Hawaii, while 52 worked at least one year outside the U.S. These numbers for the regions of work experience appear to align with those of the respondents' company headquarters location.

This is also true for the demographic variables such as company size, work location, headquarters location, field experience, management experience, technical experience, and highest level of education. Of special interest were the certifications that the respondents held. According to the survey, 78 percent or 235 of them had certifications issued by IICRC, 58 percent or 173 by RIA, 23 percent or 69 by Indoor Air Quality Association (IAQA), 18 percent or 53 by other organizations. Other organizations include

the Asbestos Institute, NADCA, and ASPE. Only 28 respondents, nine percent, claim no certification of any industry-relevant type.

### *Subject Descriptive Statistics*

Tables 1 and 2 show the 29 subjects rank-ordered by the mean score on a Likert six-scale: very important, 6; important, 5; somewhat important, 4; somewhat unimportant, 3; unimportant, 2; and very unimportant, 1. The means of the subjects ranged from 5.47 for safety and health requirements to 4.43 for green building disaster restoration techniques. It is logical to accept as clearly important the 16 subjects with mean scores of 5.0 or above. The 10 subjects between 4.5 and 5.0 can be adjudged reasonably important in the eyes of the respondents. The importance of the four subjects that averaged a score at or below 4.52 might be questioned; but including those bottom subjects in a Certified Restorer body of knowledge is not surely inappropriate. Even the low 4.43 mean was well above the 4.0 of the somewhat important rank.

### *Subject Inferential Statistics*

The process of statistical inference enables researchers to broadly predict characteristics of a population on the basis of sample data. Inferential statistics might permit investigators to find apparent causal relationships between variables for which responses seem interrelated (Keller and Warrack, 1997).

#### *ANOVA*

The researchers applied the one-way ANOVA to find the significant correlations between respondent demographic factors and their rankings of each BoK subject. The significance level chosen for the test was $\alpha = 0.10$, which means the investigators prefer a 10 percent chance of finding a significant difference when none exists, rather than overlooking significance that may exist (Shea, 1996).

Tables 1 and 2 list the p-values calculated for each subject when SPSS analyzes the response variance for the various demographics. The three decimal place numbers are p-values. If statistical p-values are less than 0.10, then respondent groups within that demographic rank the subject differently in a statistically significant way. If they view the subject's importance differently, then the contradictory judgments of the respondent categories within that demographic might cause them to draw upon and apply knowledge of the subject differently, too. The smaller the p-value, the greater the evidence of significant differences in how respondents within any demographic's alternative categories perceive the importance of the subject.

Table 1

Table 2

Responses on the basis of years of experience, whether managerial, technical, or field resulted in few subjects being ranked differently. Their duration of time spent performing restoration activities does not seem to have nearly as much influence on respondents' perceptions of subject importance as do the demographics about certification, education level, scale (size) of the organization, or headquarters location.

The lead author found during earlier research that seniority in construction management positions had nowhere near the impact on project managers' perceptions of the importance of executive management knowledge subjects as did their education majors and education levels (Rapp, 2004). Education is associated with similar significant differences among perceptions of subject importance in this case, too. Of course, some experience doing restoration work is essential to understand the challenges and constraints of implementing knowledge and to reinforce its optimal application.

There is evidence that restorers' formal learning and the certification credential that may result are critical to gain professional judgment about subjects generally held to be important for disaster restoration activities. The apparent impact of formal learning and the certification process on respondent judgment about topic importance indicates that conscientious restorers should not rely solely on work experience that happens to come their way, often similar from job to job, as the primary or only means of learning about the many aspects of their profession. Considering the impact of this observation, qualifications to obtain the CR certification, while still including some amount of relevant experience, should probably carefully consider the formal restoration-related educational and training backgrounds of prospective certificants who sit for the CR examination.

Factorial experimental designs can be cumbersome and expand the scope of any investigation. The researchers deem limited application of a multi-factor ANOVA to be within the scope of this investigation only if focused on demographics that might have significant interaction. Certification, education level, and highest degree major all deal with education and training and include the greatest number of subjects--13, 10, and nine, respectively--for which responses were significantly different. The results of a three-factor ANOVA among those demographics showed eight significant interactions between certification and education level and eight between certification and highest degree major. The significant influence of certification on responses remained.

*Practical Significance of Differences among Responses Due to Certification*

The impact of certification on survey responses is of greatest importance among the demographics, due to the purpose of the investigation. Certification was the demographic that displayed the greatest number of significantly differently ranked subjects, 13. On one hand, RIA and IICRC certified respondents tended to be less different in their responses. This is perhaps not surprising, since RIA accepts some of the IICRC certifications to partly earn their CR credential. On the other hand, respondents with no certification or with IAQA certification exhibited the greatest disparity in their rankings—usually

grading the subject matter of lower importance than did other certification categories. Statistical significance may not be of practical significance. To ascertain practical differences, an important step beyond only finding statistically significant differences, a cross tabulation analysis yielded useful insights. A summary follows for the typical responses among the certification groups for each of the 13 subjects for which those responses were statistically significantly different:

*Organizational structure.* About 55 percent of the RIA and IICRC certificants considered this important or very important, but this is only slightly higher than IAQA or non-certified respondents rank the subject.

*Quality control and assurance.* More than 80 percent of IICRC certificants scored this as important or very important, but RIA and IAQA certified respondents considered it somewhat less important; and those without a relevant certification viewed it to be much less so.

*Communication techniques.* A larger fraction of non-certified than certified respondents, 57 percent, rank this as very important.

*Structural drying science.* Non-certified restorers do not score this as very important nearly as often as those who are certified.

*Environmental protection.* Although statistically significant, the differences are not practically significant for this subject.

*Project contract terms, conditions, and common disputes.* More than 80 percent of respondents holding a certification of some type consider this subject important or very important, while fewer than 70 percent of those without a certification do so.

*Influence of building functional systems characteristics.* Almost half of IAQA certificants, more than those certified by RIA and IICRC, regard this subject as very important, while barely one-quarter of those without a certification adjudge it so.

*Hazardous material management.* RIA and IAQA certificants rated this subject somewhat lower than IICRC certificants.

*Project start-up, mobilization, and close-out.* IAQA respondents rank this subject as less important than do the other groups.

*Meeting and negotiation.* IAQA respondents rank this subject as less important than do the other groups.

*Project delivery mechanisms.* IAQA respondents rank the importance of this subject noticeably lower than do the other groups.

*BIM applied to restoration.* Non-certified and IAQA-certified respondents rate this subject lower than do RIA and IICRC respondents.

*Historical building and artifact restoration techniques.* Respondents without a certification view this subject to be more important than do those who are certified.

One notes that RIA and IICRC certificants generally, not always, consider management-related subjects more important than do respondents of the other certification categories, especially IAQA certificants. The practical significance of this finding is that Certified Restorers should probably be the professionals one looks first to hire for disaster restoration management issues.

*Factor Analysis*

Factor analysis enables grouping of the subjects by their correlation to each other. This helps one see broader, underlying factors that influence respondents to view the subjects as they do. Once identified, factors might also lend themselves to structuring the body of knowledge in a way that makes good sense. This would enable more coherent integration of the subject matter and, thus, more efficiency of instruction. The analysis of this survey data resulted in the 29 subjects or "variables" being compiled into six factors. The six factors are segregated into two groups, one as managerially-focused factors and the other as technically-focused:

Table 3

Table 4

The subject of psychology and sociology of losses and disasters correlates greatest with the subjects of Factor 1, but it could be included with Factors 2 or 6. Judgment must be applied in naming any of these factors. The act of naming them, if inaccurate, could lead to misunderstanding and cause others to include what should not be in the factor or to exclude what should be (Kachigan, 1991). Other investigators might discern and name the factors differently. The authors inferred these factor titles and acknowledge that they may not be ideal, although they have received no better suggestions at the time of writing. These six factors capture 62.1 percent of the variation among responses, and the respective fraction captured by each is stated. The hierarchy of knowledge is structured in Figure 1.

- Factor 1. Project administration. Explains 15.6 percent of the variation.
- Factor 2. Materials science and contents restoration. Explains 12.1 percent of the variation.
- Factor 3. Structural restoration processes and methods. Explains 11.8 percent of the variation.

- Factor 4. Project controls. Explains 8.9 percent of the variation.
- Factor 5. Peripheral restoration concerns. Explains 8.3 percent of the variation.
- Factor 6. Marketing. Explains 5.4 percent of the variation.

The subjects of water loss restoration, fire and smoke restoration, and mold remediation, which were deliberately omitted from the survey, should be grouped among the technical factors. The subject of ethics seems best addressed within project administration.

*Figure 1*: Chart of a body of knowledge for the Certified Restorer® credential. This forms a good basis for what disaster restoration managers should know.

## Conclusion

The results of the survey analysis enable the RIA to better determine what subject matter should be emphasized for their CR credential. A number of management and administrative topics tend to be ranked as more important than those that are more technical process-oriented. Safety and health; cost estimating and control; organizational structure; quality control and assurance; and communication techniques are deemed the most important topics by a statistically significant number of disaster restoration practitioners. Other management subjects are also ranked higher than some of the technical topics. It seems that the RIA should consider including more management and administrative instruction in future disaster restoration education for CRs.

Managers associated with disaster restoration of public or private facilities can evaluate the survey results to better appreciate the kinds of knowledge that they should have and the skills that they should be able to deliver. They can be better mentors to budding professionals. Including these subjects in education and training required for the CR credential and devoting more time to those that are deemed more important will ensure more certain success of a restoration project. The selection of a contractor with the Certified Restorer® or a similar credential should reduce the risk of owners or their agents hiring professionals whose knowledge is insufficient for the array of circumstances that typical disasters, large or small, might impose on restorers.

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